Strategy of Exercise for Heart Protection

SHU-KEUNG KWONG

From Department of Medicine, Alice Ho Miu Ling Nethersole Hospital, Hong Kong SAR

KWONG: ***Strategy of Exercise for Heart Protection.*** *Exercise is a known cardiovascular preventive measure and is also considered an intervention to disease progression. Regular endurance exercise results in improved functional capacity, while regular resistance training leads to increased strength. Exercise has the effect of modifying traditional coronary risk factors. Exercise testing can be performed to assess an individual's cardiovascular status and exercise tolerance. Exercise prescription must be individualized and it requires the consideration of appropriate frequency, intensity, duration, modality and possible side effects. For primary prevention, non-competitive exercise methods with high proportions of aerobic exercise are especially useful. For secondary prevention, different strategies cater for different disease groups. In stable coronary artery disease or post myocardial infarction patients, the aims of exercise are to improve the patients' angina-free functional capacity and quality of life (symptomatic goals), and to prevent future cardiovascular events (prognostic goal). Submaximal aerobic endurance training at 50-80% of the peak oxygen uptake is generally regarded as the gold standard. In CHF patients, exercise interventions are based on aerobic steady-state exercise sessions at 50-70% of the peak oxygen uptake for 15-30 minutes 3-5 times per week. In post cardiac surgery patients, formal exercise training with aerobic endurance exercise may be initiated when wound healing is adequately advanced. To mitigate the loss of muscle strength and mass associated with prolonged bed rest, resistance exercises may be introduced into the training program. The risk-benefit ratio of exercise training should be examined for each individual and safety of exercise training should be ensured. (J HK Coll Cardiol 2006;14(Suppl 2): B69-B72)*

Cardiac rehabilitation, chronic heart failure, coronary artery disease, exercise, exercise training, myocardial infarction

摘要

運動是已知的一種心血管疾病預防措施，它對於疾病的進展還具有干預作用。常規的耐力訓練能夠提高功能性貯備，而常規的阻力訓練能夠增強力量。運動能夠改善傳統的冠心病危險因素。運動測試用於評價個體的心血管狀態和耐力狀況。運動處方必須是個體化的，它需要考慮合適的頻度、強度、持續時間、方式和可能的副作用。在初級預防中，非競爭性的運動在有氧訓練中佔有很大的比例，這樣做是有效的。在次級預防中，對於不同的疾病採用不同的策略。在穩定性冠心病和心肌梗塞後病人中，運動的目的在於提高病人非心絞痛狀況下功能性貯備和生活品質（症狀性目標），並預防今後心血管事件的發生（預後目標）。最高量的有氧耐力訓練，達到氧攝入峰值的50-80%，通常認爲是金標準。在慢性心衰竭的病人中，運動干預是基於有氧準備狀態下，達到氧攝入峰值的50-70%，持續15-30分鐘，每週3-5次。在心臟手術術後的病人，常規的有氧耐力訓練可以開始於傷口癒合之後。爲了減輕長時間床上休息引起的肌肉力量丟失和體重下降，在訓練計劃中應引入阻力訓練。每個病人都應該作運動訓練風險– 收益比值的考核，運動訓練的安全必須是要保證的。

關鍵詞：心臟病復康　慢性心衰竭　冠心病　運動　運動訓練　心肌梗塞

Exercise Physiology

Exercise results in a significant increase in cardiac output. Both heart rate and stroke volume increases in exercise. The increase in heart rate during exercise accounts for more of the increase in cardiac output than does the increase in stroke volume. Increase in plasma norepinephrine and epinephrine levels constrict most of vessels, except those in the muscles and the coronary and cerebral circulation.

Endurance or isotonic exercise (contraction of large muscle groups resulting in movement) causes a volume load on the heart, while resistance or isometric exercise (constant muscular contraction of smaller

Address for reprints: Dr. Shu-Keung Kwong
Department of Medicine, Alice Ho Miu Ling Nethersole Hospital, Tai Po, N.T., Hong Kong SAR, China

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muscle groups without movement) tends to exert a pressure load on the heart. Regular endurance exercise results in improved functional capacity, while regular resistance training leads to increased strength. After a period of exercise training, the improvement in functional capacity and strength allows an individual to exercise to higher peak workrates with lower heart rates at each submaximal level of exercise.

Benefit of Exercise

Exercise has the effect of modifying traditional coronary risk factors. Firstly, exercise causes weight reduction and improves fat distribution. Secondly, exercise was associated with some reduction in mean systolic blood pressure and diastolic blood pressure. Thirdly, exercise has beneficial effects on glucose metabolism and insulin sensitivity. Finally, exercise results in increase in high-density lipoprotein (HDL) level and reduction in triglyceride and low-density lipoprotein (LDL) levels.

Exercise also has beneficial effects on thrombosis, endothelial function and autonomic function.

Assessment of Exercise Tolerance

Exercise testing can be performed to assess an individual's cardiovascular status and exercise tolerance.

Individualized Exercise Regimen

Exercise prescription must be individualized based on an individual's specific characteristics, abilities, exercise testing and comorbidities. The prescription requires the consideration of appropriate frequency, intensity, duration, modality and possible side effects. As an individual becomes more conditioned, the exercise prescription should be advanced. For most individuals, intensities within the range of 65% to 85% maximum heart rate are sufficient to achieve improvements in cardiorespiratory fitness when combinded with an appropriate frequency and duration of training.[1]

In 1998, the American College of Sports Medicine (ACSM) updated the recommended quantity and quality of exercise for developing and maintaining cardiorespiratory fitness in healthy adults.[2] The recommendations for cardiorespiratory endurance exercise are: mode of using large muscle group, frequency of 3 to 5 days per week, duration of 20 to 60 minutes, and intensity of 55% and 65% to 90% of maximum heart rate. For older and deconditioned individuals, an exercise intensity on the lower side of the recommendation can also be effective in improving cardiorespiratory endurance.

Many centers use Borg's rating of perceived exertion (RPE) for the patients to express how hard they perceive when they are exercising. It is a tool to help patients become good perceivers of their exertion. It helps patients to control exercise intensity, which is safe and effective to them, in whatever modes during training and also in their daily living when they are not supervised.

Primary Prevention

For primary prevention, non-competitive exercise methods with high proportions of aerobic exercise are especially useful. The prognostic benefit has so far only been established for aerobic endurance training. Resistance training cannot be generally recommended in the context of primary prevention. AHA/ACC propose that each individual should engage in 30 minutes of moderate intensity physical activity on most, preferably all, days of the week.

Secondary Prevention

Different strategies of exercise cater for different disease groups and exercise is an important component of cardiac rehabilitation.

Firstly, in stable coronary artery disease or post myocardial infarction patients, the aims of exercise are

to improve the patients' angina-free functional capacity and quality of life (symptomatic goals), and to prevent future cardiovascular events (prognostic goal). To minimize the individual risks of exercise training, patients should be stratified according to the AACPR Guideline for Cardiac Rehabilitation and Secondary Prevention Programs into lowest, moderate and highest risk groups.[3] Although both low- and high- risk patients may participate in training programs, the degree of supervision and monitoring will be different. Submaximal aerobic endurance training at 50-80% of the peak oxygen uptake is generally regarded as the gold standard. Upper heart rate for training should be set at 10 beats below angina or ischemic threshold. Exercising large muscle groups through rhythmic activity, such as brisk walking, cycling, rowing or stair climbing, is often used. Gradual stepping up of the excise intensity and duration is desirable in achieving the final exercise goal. Recently, resistance training has been increasingly applied as an additional training modality in low risk patients. In most of the stable patients, three to four moderate intensity exercise training sessions per week, with duration of 30-40 minutes each, are necessary to obtain optimal results. Weekly energy expenditure >1500 kcal per week is considered beneficial. For patients immediately after acute myocardial infarction, the goals are to minimize the deconditioning. Simple exposure to orthostatic or gravitational stress (by intermittent sitting or standing) and range of motion exercises are useful. This is followed by performance of daily activities and should be restricted to 2-3 metabolic equivalents (METS) or less than 13 RPE (Borg's rating). When patients are stabilized about 2 weeks after acute myocardial infarction, aerobic exercise training could start with the lower end of their training intensity (40% to 60% of peak oxygen uptake).

Secondly, in stable patients with chronic heart failure (CHF), a detailed diagnostic evaluation including echocardiography and treadmill test should be available before initiation of exercise training. Training interventions in CHF are based on aerobic steady-state exercise sessions at 50-70% of the peak oxygen uptake for 15-30 minutes 3-5 times per week. In highly symptomatic patients with very low symptom-free exercise tolerance, shorter training sessions at low intensity (50% of VO_2 max) may be required. Duration of exercise may need to be adjusted to allow patients more opportunity for rest and to progress at patients' own pace. When patients tolerate this regimen well, first the session duration should be prolonged, then training intensity can be increased. Resistance exercise has been an intervention to antagonize the wasting syndrome in advanced heart failure. Based on observational studies, single-limb short-term resistance exercise seems to be safe.

Thirdly, in patients after cardiac surgery, they are confronted with several additional problems: reduced ventilatory capacity in the immediate postoperative period, pain during respiration and lifting arms, weight reduction due to the catabolism associated with surgical trauma and immobilization. Limited physical exercise starts immediately after surgery in the form of mobilization, followed by a highly supervised mobilization and respiratory training, to prevent postoperative complications of pneumonia or deep vein thrombosis. When the patient is in stable postoperative condition, mobilization including active and passive exercise, respiratory exercise and walking may start early after surgery. Formal exercise training with aerobic endurance exercise may be initiated when wound healing is adequately advanced. To mitigate the loss of muscle strength and mass associated with prolonged bed rest, resistance exercises may be introduced into the training program. However, upper limb resistance training should be avoided until sternal healing has occurred, generally 8 weeks after surgery. Elastic bands and hand weights could be used to train upper limbs before progressing to resistance exercise machines.

Finally, for patients with valvular heart diseases, there are clear contraindications to exercise training including all critical and highly symptomatic valvular lesions on the edge to cardiac decompensation. In addition, a stable aortic stenosis with aortic valve area of <0.75 cm^2 and a peak pressure gradient of >50 mmHg is also generally regarded as a contraindication to training programs. In valvular heart disease, changes in afterload or preload associated with changes in peripheral resistance may greatly affect cardiac output. Therefore, resistance training of large muscle groups

is generally discouraged in valvular heart disease. Endurance training, preferably with ECG and blood pressure monitoring during the initial phase, is better reproducible with regard to hemodynamic load.

Safety of Exercise

The risks of exercise training must be considered to promote the health benefits of exercise while minimizing injury. The risk-benefit ratio should be examined for each individual. Major hazards involve the cardiovascular and musculoskeletal systems. The incidence of sudden cardiac death during exercise for population at large is 1 in 565,000 events per hour.[4]

General rules of safety should be observed. Five to ten minutes of warm-up and cool-down exercise before and after the main exercise training would allow better cardiovascular and musculo-skeletal adaptation and reduce injury and discomfort. The purpose of the warm-up is to prepare the muscular, nervous, cardiac, respiratory and vascular systems for the main workout. It prepares the body for the change from rest to exercise. The warm-up should be carried out at a low intensity and speed, repetition and exertion should be progressively increased. This graduated approach allows the heart to adapt to increased demand and to avoid myocardial ischemia and arrhythmia. The warm-up should include: pulse-raising exercises, mobility exercises and preparatory stretches. Proper cool-down exercise would also help to reduce hypotension, arrhythmia and ischemia after exercise training. The cool-down should consist of pulse-lowering exercises, which aim to reduce the heart rate and blood pressure gradually. Attention should also be paid to the nutrition, diet, clothing and footwear during exercise training. Full meal and alcohol should be avoided prior to exercise. Patient should also take the usual medication on the day of exercise training.

Most asymptomatic persons do not need to see their physicians before starting a moderate intensity physical activity program. However, it is advised that men older than 45 years and women older than 55 years who plan to start a program of vigorous intensity (>60% VO_2max) or individuals with risk factors, signs, or symptoms of cardiovascular or chronic disease consult their physician to design an exercise program. Individuals of high risk should have thorough medical assessment before having exercise training and they would require electrocardiographic monitoring during exercise training.

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Further Readings

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