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Original article

Effects of isometric exercise on hypertension

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Abstract

Hypertension is a serious problem in modern society. Between the ages of 60 and 74, the prevalence of hypertension is almost double its age-adjusted prevalence among people under 60 years old. Physical activity and cardiorespiratory fitness are important influences on blood pressure. Most physical activity interventions have utilized aerobic exercise, but recent studies suggest that isometric exercise is safe and has favorable effects on physical fitness, hypertension, and the psychological status. Isometric exercise in hypertensive populations appears to maintain the reductions in blood pressure achieved by endurance training, and may even elicit further reductions in blood pressure. However, as I am indicating, resistance training is not the only recommended approach to lower blood pressure, but should play a prominent role in any program designed to do so.

Key words: hypertension isometric fitness

1. Introduction

Hypertension is a serious problem that can lead to stroke, the progression of heart failure, kidney disease, and heart attacks. Between the ages of 60 and 74, the prevalence of hypertension is almost double its age-adjusted prevalence among people under 60 years old in the United States. In the age group of 60–74, approximately 50 percent of Caucasians, 50 percent of Mexican-Americans, and 75 percent of African-Americans have hypertension (Robert, et al., 1999).

The cause of hypertension is generally unknown in approximately 90% of cases, but it usually can be controlled effectively by medication, weight loss, a proper diet, and exercise. Regarding exercise, evidence has accumulated over the past several decades that physical activity and cardiorespiratory fitness are important influences on blood pressure. Most physical activity interventions have utilized aerobic exercise. Aerobic exercise involving moving large muscle groups in a dynamic manner has been shown to be of substantial benefit in hypertensive populations. Table 1 describes an effective exercise prescription devised by the American College of Sports Medicine for use by hypertensive individuals (Joseph and Henry, 1999).

On the other hand, individuals with hypertension have been discouraged from doing resistance exercise because of fears regarding the effect of increased blood pressure during exercise. However, recent studies suggest that this form of exercise is safe and has favorable effects on physical fitness, cardiac risk factors such as hypertension, and the psychological status. Several investigators have advocated resistance exercise alone or in combination with dynamic exercise for normo- and hypertensive populations.

Table 1 Exercise prescription to control blood pressure and develop and maintain cardiorespiratory fitness

Parameters	Description
Mode of activity	Large-muscle activity that is rhythmical and aerobic (walking, running, and cycling)
Frequency	3 to 5 days per week
Duration	20 to 60 minutes
Intensity	60% to 90% of Max Heart Rate (50% to 85% of Max Oxygen Uptake)

(Joseph and Henry, 1991)

Table 2 Classifying blood pressure*

Systolic blood pressure	Diastolic blood pressure	
Less than 130	Less than 85	Normal blood pressure
130–139	85–59	High-normal blood pressure
140–159	90–99	Stage 1 (mild) hypertension
160–179	100–109	Stage 2 (moderate) hypertension
180–209	110–119	Stage 3 (severe) hypertension
210 or higher	120 or higher	Stage 4 (very severe) hypertension

*If systolic and diastolic blood pressure levels are different, the higher level is the designated class. (Barry, 1996)

A review of the literature on the effects of isometric exercise on hypertensive populations yielded several common areas of research, including: the condition of hypertension, increasing blood pressure during exercise, the effects of isometric exercise on hypertension, and the reason why the resting blood pressure is decreased by isometric exercise. Finally, I will suggest a prescription for isometric exercise.

2. The condition of hypertension

Hypertension is defined as a systolic pressure of >140 mmHg or diastolic pressure of > 90 mmHg. The higher the levels are above 140/90, the more serious the hypertension. Table 2 describes blood pressure levels (Barry, 1996). The risk of coronary heart disease rises with increases in either the diastolic or systolic blood pressure. Although there is little disagreement that people with blood pressure of > 180 / > 105 mmHg should be treated with medication, many believe that, for those with mild hypertension (140 to 180 / 90 to 104 mmHg), pharmacological interventions should not be considered as the first-choice treatment.

3. Increasing blood pressure during exercise

Heavy-resistance exercises can lead to extreme blood pressure responses. Peak blood pressure responses were achieved during exercises performed using at least 50% of the maximum weight that could be lifted one time in novice and untrained lifters. Both systolic and diastolic blood pressures were elevated, with average values exceeding 300/200 mmHg for the two-leg press (Edward and Franks, 1997).

Thomas, et al. (1999) determined that exercise-induced hypertension carries a small but significant risk of major cardiovascular events in healthy, asymptomatic persons with a normal resting blood pressure.

4. The effects of isometric exercise on hypertension

Hagberg and colleagues (1984) demonstrated that isometric training (5 to 8 weeks) using handgrips at 30 to 50 percent of the subject's maximum isometric contraction resulted in decreases of 10 to 15 mmHg in measurements of systolic and diastolic blood pressure. James, et al. (1994) examined adolescent hypertensives to determine the effect of weight training on their blood pressure and hemodynamics. After weight training, the systolic blood pressure was lower than when measured initially. Weight training maintained the reduction in diastolic pressure caused by endurance exercise in those who initially showed diastolic hypertension. Systolic and diastolic blood pressure increased significantly after the cessation of training. In a similar study, James, et al. (1994) concluded that weight training in hypertensive adolescents appears to maintain the reductions in blood pressure achieved by endurance training, and may even elicit further reductions. Martel, et al. (1999) determined the effects of heavy resistance training on the resting blood pressure in healthy older men and women. The exercise program led to reductions in both systolic (5+2 mmHg) and diastolic (4±1 mmHg) blood pressure. Buck and Donner (1985) studied the relationship between occupational isometric activity and the incidence of hypertension. Their study found that males with jobs with a moderate to high isometric content had a 7.4 percent incidence of hypertension, compared to 10.4 percent of those in jobs with a low isometric content. This represents a 29% reduction in the incidence attributed to the daily isometric content of the job function. Stone and colleagues (1991) determined that although resistance-type exercise can cause large increases in both systolic and diastolic blood pressure during the lifting of heavy weights,

frequent exercise-induced high blood pressure does not result in elevations of the resting blood pressure. Hagberg and colleagues (1984) followed a group of borderline hypertensive adolescents through 5 months of weight training. The subjects' resting systolic blood pressures decreased significantly. These reductions were somewhat greater than those resulting from endurance training. Ishikawa et al. (1999) described the influence of age and gender on isometric training-induced blood pressure levels. They concluded that older hypertensive subjects (over 50 years) experienced smaller reductions in blood pressure than younger ones, and gender did not influence the efficacy of physical activity to lower an elevated blood pressure. Wright, et al. (1999) researched blood pressure responses to acute static and dynamic exercise in three racial groups in the United States (Caucasians, African-Americans, and Asian-Pacific Islanders). There were no significant differences between racial groups in the blood pressure response to either static or dynamic exercise. However, during exercise, men in all groups showed a higher systolic blood pressure response than women. Rogers and Hung (1996) researched and confirmed the changes in blood pressure induced by isometric exercise using a handgrip in pregnancy. Resistance training involving 8 to 10 major-muscle-group exercises two to three times per week, especially circuit weight training, may help lower blood pressure when the exercises are done at 40 to 50 percent of the patient's one-repetition maximum. Again, however, as John and Donald (1999) indicate, resistance training is not recommended as the only approach to lowering blood pressure.

5. The reason why resting blood pressure is decreased after isometric exercise

1) As previously stated, as soon as the muscles stop contracting, there is no longer a pump to propel blood back to the heart. As there is limited blood in the heart, cardiac output will markedly decline and blood pressure will drop.
2) Following exercise, there are still high concentrations of metabolic byproducts (such as lactic acid) and other substances that cause the blood vessels in the muscle to remain dilated. This allows the blood flow to these areas to remain very high, resulting in a fall in the blood volume of the heart, again causing a lowering of pressure.
3) Following exercise, the body temperature is elevated. In order to dissipate this internal heat, blood vessels in the skin open, which allow increased blood flow to the skin and the off-loading of heat to the environment. Once again, this can reduce the blood volume in the heart and result in hypotension.
4) Resistance training is associated with a favorable alteration in the lipoprotein profile (Fripp, et al., 1999).
5) Resistance training may beneficially alter glucose tolerance and insulin sensitivity (Stone, et al., 1991).

6. Exercise prescription

Resistance exercise may enhance muscular strength and endurance, the body composition, blood lipid and lipoprotein levels, and cardiovascular endurance, although further research is needed in hypertensive populations. Patients should be clinically screened and perform a submaximum exercise test prior to training. Older patients and those who have characteristics associated with an increased risk of cardiac events during exercise should avoid heavy resistance training. Free weights, cuff and hand weights, isotonic/isokinetic machines, elastics, and other resistance modalities may be used to exercise major muscle groups. Gradual acclimatization or 1-repetition maximum testing may determine appropriate resistance training workloads. The heart rate, blood pressure, rate-pressure product, and rating of perceived exertion should be determined during lifting movements. Isometric exercises combined with dynamic exercises have been recommended for hypertensive populations since many vocations involve lifting / pushing movements or frequent isometric muscle contractions. There appears to be considerable benefit and minimal risk of resistance exercise training for people with hypertension.

7. Conclusion

1) During exercise, hypertension may be a significant risk factor in healthy, symptomatic persons with a normal resting blood pressure.

2) Isometric training prescribed at 30 and 50 percent of the 1-repetition maximum resulted in decreases in blood pressure.
3) Weight training in hypertensive adolescents appears to maintain the reductions in blood pressure achieved by endurance training, and may even elicit further reductions in blood pressure.
4) Occupational isometric activity also can reduce blood pressure.
5) The reduction of blood pressure by isometric exercise is smaller in older (over 50 years) than in younger hypertensive subjects.
6) Gender did not influence the efficacy of physical activity for lowering elevated blood pressure.
7) There were no significant differences between racial groups in the blood pressure response to either static or dynamic exercise.
8) Resistance training is not recommended as the only approach to lowering blood pressure.

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