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EXERCISE AND HYPERTENSION

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Physical inactivity and hypertension

Cardiovascular diseases (CVDs) account for a large proportion of mortality in adults older than 45 years. Numerous risk factors for CVD including hypertension, diabetes, obesity and hypercholesterolemia are suspected to be influenced by fitness, and these factors may mediate the association between low fitness and mortality (1-2). Physical inactivity is strongly positively associated with hypertension. Although the evidence from observational studies is strong for an inverse relationship between physical activity level and blood pressure (BP), these studies are limited by the inability to ensure that all other factors that affect BP are the same between active and non-active groups. Young adults with low fitness were 3-to-6 fold more likely to develop diabetes, hypertension and the metabolic syndrome than those with high fitness (3).

Benefits of physical activity

The primary goal of treatment of the hypertensive patient is to achieve the maximum reduction in the long-term total risk of cardiovascular morbidity and mortality. This requires treatment of all the reversible risk factors as well as treatment of the raised BP. According to the last ESH/ESC guidelines lifestyle measures, including physical activity, should be instituted whenever appropriate in all patients, with high normal BP and patients who require drug treatment.

Exercise definition and exercise components

Exercise is categorized into two types: aerobic and anaerobic. Aerobic exercise consists of repetitive, low resistance movements (walking or cycling) that last over a long period of time (usually more than 10 minutes). Anaerobic exercise consists of high resistance, low repetition movements such as weight lifting, and last only one to three minutes. All of the recommendations focus on aerobic exercise as the primary activity. Aerobic exercise intensity has been characterized by the American College of Sports Medicine as low, moderate or high (4). Exercise is defined as low intensity if it elicits 35% to 59% of predicted maximum heart rate (PMHR; 220-subject's age), or 30% to 49% of maximum oxygen uptake (VO2 max). Moderate is that eliciting 60% to 79% of PMHR, or 50% to 74% of VO2 max. Exercise eliciting a greater response is considered high intensity (Table1). Moderate-intensity activity for most people is comparable to a brisk walking pace of 4.5 to 6 km per hour, and high intensity activity is comparable to joking or running. The exercise regimens tested in most studies have used a frequency, intensity and duration based on the American College of Sports medicine exercise prescription for improving cardiorespiratory fitness (4).

Parameter	Description
Mode of activity	Aerobic exercise that is repetitive, low resistance movements (walking or cycling) that last over a long period of time
Frequency	3 to 4 times per week
Duration	at least 30 to 45 min
Intensity	at least moderate, 60% to 79% of PMHR, or 50% to 74% of VO2 max

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

Clinical Trials

Persons who are physically fit maintain a more favorable caloric balance and lower body weights, both of which protects against the development of CVD risk factors. Regular physical activity was associated with significantly reduced risk for hypertension in men and women, independent of age, education, smoking habits, alcohol intake, a history of diabetes, BMI, and systolic blood pressure at baseline. A meta-analyses, which was included 54 clinical trials comprising 2419 participants, assessed the effects of aerobic exercise on BP. Aerobic exercise was associated with a significant reduction in mean systolic BP by 3.8 mm Hg and diastolic BP by 2.6 mm Hg (5). Because the BP reductions related to aerobic exercise did not significantly differ among trials with various types, frequencies, and intensities of exercise intervention, the result from this meta-analyses indicated that all forms of exercise seemed to be effective in reducing BP. A prospective study among Harvard male alumni reported that men who did not participate in vigorous exercise had a 35% higher incidence of hypertension than those who were more active (6). The ARIC study pointed out that leisure time physical activity reduced the risk of hypertension in middle-aged white men but not in black (7). Kokkinos P. et al. found that African-American men with severe hypertension and LVH benefit from a combined regimen or regular, moderately intense aerobic exercise and antihypertensive treatment. The antihypertensive effects of exercise substantially reduced the amount of medication required to control blood pressure (8). We assessed the relationship between aerobic fitness and 24-h BP in men and women with resting BP 160/100 mm Hg not treated with antihypertensive treatment. In our population of over 500 men and women, we noted that higher fitness levels were associated with lower BP levels in both genders. The daytime systolic BP for women who achieved approximately 10 METs (moderate fit) and 11 or more METs (high fit) during an exercise treadmill test was 7 mm Hg and 10 mm Hg respectively lower than women in low fit category. Also Trichopoulou et al. found that the hazard ratio for death in Greeks following the high score of the Mediterranean diet and physical activity >35 METs-hr/day was 0.83 versus 0.74 for those following low score of the Mediterranean diet and physical activity <35 MET-hr/day (9). Only two prospective studies assessed the association of physical activity with the risk of hypertension in men and women separately, and no significant association was found among men. Mechanisms suggested to account for these observations are reduced systemic vascular resistance, decreased cardiac output, and decreased plasma noradrenaline concentrations. Exercise promotes muscle insulin sensitivity, insulin mediated transport of glucose from blood to muscles, improved autonomic nervous system function and lower heart rates, which each decrease the risk of developing diabetes, independent of body

mass (10). Increased lipoprotein lipase activity in active skeletal muscle, which result in an enhanced clearance rate of plasma triglycerides; increased transport of lipids and lipoproteins from the peripheral circulation and tissue to the liver; and enhanced HDL cholesterol, are mechanisms by which lipids may improve with fitness (2). Physical exercise stimulate NOS3 activity and increases NO release through the augmentation of sheer stress, and thereby is considered generally to lower BP. Kimura T. et al. found a significant interaction between the genotype and physical activity level on systolic BP in the Japanese population (11), while Franks PW et al. found that the knowledge of GPR10 genotype may define those who are least likely to benefit from physical activity(12).

Exercise programs may lead to additional benefits when combined with other life style interventions. The combination of regular physical activity and weight control can reduce the risk of hypertension in both sexes regardless the level of obesity (13). The recent Finnish Diabetes Prevention study (14) showed that, in overweight subjects with glucose intolerance who received intensified life style intervention (diet intervention and moderate exercise for at least 30 min per day), the long term reduction in body weight was 3 to 3.5 kg compared with control subjects. This intervention resulted not only in a marked reduction in the risk of developing type 2 diabetes, but also in a significant drop in blood pressure (4 mm Hg for systolic and 2 mm Hg for diastolic BP compared with control subjects).

ESH/ESC Recommendations

Physical fitness is a rather strong predictor of CV mortality independent of BP and other risk factors. Thus sedentary patients should be advised to take up a modest level of aerobic exercise on a regular basis, such as walking, jogging or swimming for at least 30-45 min, three to four times a week. The extent of the pretraining evaluation will depend on the extent of the exercise program and on the patient's symptoms, signs, overall cardiovascular risk and associated clinical conditions. Even mild exercise may lower BP 4-8 mm Hg. However, isometric exercise such as heavy weightlifting can have a pressor effect and should be avoided. If hypertension is poorly controlled, and always in severe hypertension, heavy physical exercise should be discouraged or postponed until appropriate drug treatment has been instituted and found to be effective (15).

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