HYPERTENSION IN ATHLETES

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Introduction

Blood pressure increases with age. Systolic blood pressure continues to increase throughout adult life, related to progressive arterial stiffening, whereas diastolic blood pressure plateaus in the sixth decade of life and decreases thereafter. The prevalence of hypertension in the population amounts to ~25%. When broken down by age and gender, the prevalence is approximately 15%, 30%, and 55% in men aged 18–39 yrs, 40–59 yrs, and ≥ 60 yrs, respectively, and about 5%, 30%, and 65% in women in these age groups. These epidemiological data indicate that hypertension may already be present in the young athlete, though rarely, but will occur more frequently in the older sportsman. However, ~ 25% of patients with hypertension by conventional measurements have a normal blood pressure on 24-hour ambulatory monitoring or on home blood pressure measurements, so-called white-coat hypertension [1], and it has been shown that young athletes with clinical hypertension often have normal blood pressure on ambulatory monitoring [2].

Approximately 95% of patients with hypertension have essential or primary hypertension which results from an interaction between genetic factors and lifestyle/environmental factors including being overweight, high salt intake, excessive alcohol consumption, and physical inactivity. However, the role of blood pressure increasing ergogenic aids should be considered in the hypertensive sportsman or athlete. Athletes may be taking unsafe doses of prohibited substances such as anabolic steroids, erythropoietin, stimulants, and so forth. The uncontrolled use of these agents has been associated with numerous side effects including hypertension. In addition, the use of non-steroidal, anti-inflammatory drugs should be limited in young athletes, since these compounds may increase blood pressure and are commonly used in the athletic setting.

Assessment of the severity of hypertension and risk stratification

The severity of hypertension does not only depend on the blood pressure level but also on the presence of other cardiovascular risk factors, target organ damage, and cardiovascular and renal complications, so patients are accordingly classified as having low, moderate, high, or very high added risk in comparison with healthy normotensives without risk factors [3]. With regard to left ventricular hypertrophy, it should be noted that sports activity itself may induce hypertrophy; the type of hypertrophy and assessment of diastolic left ventricular function may help to distinguish between hypertensive heart disease and athlete’s heart [4–8]. Although athletes maintained diagnosis, and is generally considered a physiological adaptation to training, in contrast to the hypertrophy secondary to hypertension. Hypertensive patients usually have concentric left ventricular hypertrophy, but eccentric hypertrophy has also been described [9]. Whether or not hypertension in an athlete will trigger or accentuate the cardiac hypertrophy, or athletic exercise in a person with hypertrophy secondary to hypertension will worsen the hypertrophy, is not known.

Assessment of the risk associated with exercise

Exercise-related sudden death at a younger age is mainly attributed to hypertrophic cardiomyopathy, anomalies of the coronary arteries, or arrhythmogenic right ventricular dysplasia [8, 10–12] and is unlikely to be related to hypertensive on the other hand, coronary heart disease has been identified in approximately 75% of victims of exercise-related sudden death above the age of 35 years. Whether high blood pressure is a cause of exercise-related sudden death on its own is not known, but hypertension is certainly a major risk factor for the development of coronary artery disease. In addition, hypertensive-induced left ventricular hypertrophy may cause life-threatening ventricular arrhythmias [13]. It is likely that the risk associated with exercise can be derived from the overall risk stratification. Therefore, the general approach to the hypertensive patient should also apply to the exercising patient.

Diagnostic evaluation

Diagnostic procedures are aimed at 1) establishing blood pressure levels; 2) identifying secondary causes of hypertension; 3) evaluating the overall cardiovascular risk for other risk factors, target organ damage and concomitant diseases or accompanying clinical conditions [3]. Diagnostic procedures comprise a thorough individual and family history, physical examination including repeated blood pressure measurements according to established recommendations, of which some should be considered part of the routine approach in all subjects with high blood pressure, some are recommended, and some are indicated only when suggested by the core examinations. In addition, echocardiography and exercise testing with ECG and blood pressure monitoring are indicated as routine tests in the competitive athlete with hypertension [14, 15]. In the common hypertensive sportsman, the indication for exercise testing depends on the patient’s risk and on the amateur/leisure-time sports characteristics [15, 16] (Table 1). In patients with hypertension about to engage in hard or very hard exercise (intensity ≥ 60% of maximum), a medically supervised peak or symptom-limited exercise test with ECG and blood pressure monitoring is warranted. In asymptomatic men or women with low or moderate added risk, who engage in low-to-moderate physical activity (intensity < 60% of maximum), there is generally no need for further testing beyond the routine evaluation. Asymptomatic individual patients with high or very high added risk may benefit from exercise testing before engaging in moderate-intensity exercise (40–60% of maximum) but not for light or very light activity (< 40% of maximum). Patients with exertional dyspnea, chest discomfort, or palpitations need further examination, which includes exercise testing, echocardiography, Holter monitoring, or combinations thereof.

A major problem with exercise testing in a population with a low probability of coronary heart disease and in subjects with left ventricular hypertrophy is that the majority of positive tests on electrocardiography are falsely positive. Stress myocardial scintigraphy or echocardiography, and ultimately coronary angiography, may be indicated in cases of doubt. There is currently insufficient evidence that the blood pressure response to exercise should play a role in the recommendations for exercise in addition to blood pressure at rest [17]. However, subjects with an excessive rise of blood pressure during exercise are more prone to develop hypertension and should be followed-up more closely [15]. Finally, physicians should be aware that high blood pressure might impair exercise tolerance [18].

Effects of exercise on blood pressure

Dynamic exercise

Blood pressure increases during acute dynamic exercise in proportion to the intensity of the effort [18, 19]. During longer-term stable exercise, the blood pressure tends to decrease after an initial increase of short duration. The increase is greater for systolic than for diastolic blood pressure which only slightly increases or even remains unchanged. For the same oxygen consumption, the rise is more pronounced in older subjects and when exercise is performed with smaller rather than with larger muscle groups. Acute exercise is usually followed by post-exercise hypotension which may last for several hours and is generally more pronounced and of longer duration in patients with hypertension than in normotensive subjects [16, 19].

Cross-sectional and longitudinal epidemiological studies indicate that physical inactivity and low fitness levels are associated with a) higher blood pressure levels and b) increased incidence of hypertension in the population [20]. Meta-analyses of randomized controlled intervention studies concluded that regular dynamic endurance training at moderate intensity significantly reduces blood pressure [21–23]. A recent meta-analysis involved 72 trials and 105 study groups [23]. After weighting for the number of participants, training induced significant net reductions of resting and daytime ambulatory blood pressure of, respectively, 3.02/4.4 mm Hg (P < 0.001) and 3.29/5.4 mm Hg (P < 0.01) were calculated. The reduction of resting blood pressure was more pronounced in the 30 hypertensive study groups (~6.9–4.9) than in the others (~1.9–1.8) (P < 0.001 for all). There was no convincing evidence that the blood pressure response depended on training intensity between ~40% and ~ 80% of maximal aerobic power [21, 23].

Static exercise

Blood pressure increases during acute static exercise, and the increase is more pronounced than with dynamic exercise, particularly with heavy static exercise at an intensity of > 40–50% of maximal voluntary contraction. In a recent meta-analysis of randomized controlled trials, ‘resistance’ training at moderate intensi-
Moderate added risk
- History, PE, ECG, ET, echo
- Well controlled BP and risk factors
- All sports, with exclusion of high static, high dynamic sports (III C)
- Only low-moderate dynamic, low static sports (I A–B)
- Yearly

Very high added risk
- History, PE, ECG, ET, echo
- Well controlled BP and risk factors; no associated clinical conditions
- Only low-moderate dynamic, low static sports (I A–B)
- 6 months

Follow-up

References


