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HYPERTENSION

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Summary

Hypertension is an established and independent risk factor for stroke, coronary heart disease, and heart and kidney failure. The relationship between blood pressure and cardiovascular risk is continuous with no threshold. Blood pressure increases with age and is on average higher in men than in women. The cause of elevated blood pressure in most cases is unknown but it is a self-amplifying condition that is more amenable to treatment in its early stages. Consequently, lowering blood pressure in the whole population including normotensive individuals contributes to lowering the burden of cardiovascular disease. Convincing evidence exists for the effects of overweight/obesity and of high intakes of alcohol and salt on increasing blood pressure. Pharmacologically high intakes (>3 g/day) of long-chain n-3 polyunsaturated fatty acids lower blood pressure but not intakes within the range of normal dietary intakes (up to 2 g/day). There is probable evidence to show that the consumption of low-fat milk products is associated with lower blood pressure and for an increased intake of calcium to be associated with a reduced risk of hypertension. There is a probable relationship between low potassium intake and increased blood pressure, and possible relationships with the intakes of nitrate. Low birth weight and poor growth in early life are associated with an increased risk of developing hypertension. Meta-analyses of randomized controlled trials show convincing evidence that salt reduction, moderation of alcohol intake, and weight loss in the overweight/obese lower blood pressure. An integrated dietary approach involving a global change in dietary pattern appears to be more effective in lowering blood pressure than single dietary interventions.

Introduction

High blood pressure or hypertension is classified as systolic blood pressure of 140 mm Hg or above and diastolic blood pressure of 90 mm Hg or above, or being on specific treatment (Table 46.1). Elevated blood pressure is a major modifiable risk factor for cardiovascular disease, and especially stroke. Severe hypertension results in end-organ damage, particularly to the microvasculature of the retina, brain, and kidney, and is an important cause of blindness, dementia, and chronic renal failure (Box 46.1). However, the hazards of cardiovascular disease associated with blood

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TABLE 46.1 Classification of blood pressure (mm Hg) based on seated clinic blood pressure

Condition	Systolic BP	Diastolic BP
Ideal	<120	<80
Pre-hypertension	120–139	80–89
Hypertension	140–159	90–99
Grade 1	140–159	90–99
Grade 2	160–179	100–109
Grade 3	>180	>110

BOX 46.1 Major hazards of hypertension

Cardiovascular disease
- Stroke
- Coronary heart disease
- Peripheral vascular disease

Renal failure
Retinal damage

pressure extend well into the normal range, and the hazards are greater in the presence of other risk factors (increasing age, high blood cholesterol, smoking, diabetes mellitus, and target organ damage). Data from the analysis of prospective cohort studies (Lewington *et al.*, 2002) show that all-cause mortality, stroke, and coronary heart disease (CHD) incidence increase on a doubling scale (log-linear) with increasing blood pressure. This has led to the conclusion that the relationship of blood pressure and risk of cardiovascular disease has no threshold. There is convincing evidence that lowering raised blood pressure using drugs reduces mortality, especially from stroke but also from CHD (Czernichow *et al.*, 2011). It has been difficult to demonstrate benefit from lowering blood pressure below 120/80 mm Hg in high-risk groups such as people with type 2 diabetes (Cushman *et al.*, 2010).

The prevalence of hypertension increases with age so that the majority of people over the age of 50 are at risk or are already hypertensive in economically developed areas of the world; this age group carries the greatest population attributable risk of cardiovascular disease (Lewington *et al.*, 2002). Measuring blood pressure is subject to substantial measurement error and bias. The use of automated sphygmomanometers reduces bias such as digit preference and cut-offs for diastolic blood pressure. However, equipment needs to be regularly calibrated, and elevated readings may be obtained when subjects are stressed ("white-coat hypertension"). Ambulatory blood pressure monitoring devices provide more robust measures of blood pressure, but give values that are 5 mm Hg lower than clinic seated blood pressure (O'Brien *et al.*, 2005). The techniques used to measure blood pressure and appropriate placebos are crucial issues when evaluating diet and lifestyle effects on blood pressure.

Nationwide cross-sectional studies tend to overestimate the prevalence of hypertension because they are made on measurements on a single occasion. It is well known that blood pressure falls in response to repeat measurement, regressing towards the mean. The association of blood pressure with risk of cardiovascular disease tends to be underestimated because of resulting regression dilution bias. Adjusting for regression dilution bias by using multiple measures of blood pressure on different days gives a better estimate of true blood pressure and strengthens the relationship with risk. The absolute risk of hypertension increases markedly with age and it is in the older age groups that the benefits of treating hypertension are greatest because their absolute risk is greatest (Lewington *et al.*, 2002).

High blood pressure usually results from increased resistance to blood flow by small arterioles (resistance vessels). It is a self-amplifying process in which the arterioles develop thicker, more muscular walls in response to the increased pressure which further increases peripheral resistance when stimulated by vasoconstrictor substances or by sympathetic stimulation. Systolic blood pressure (SBP) increases with age whereas diastolic blood pressure (DBP) tends to increase in line with SBP until the sixth decade and then tends to fall. Stiffening of the large arteries occurs with aging and this contributes to hypertension and is emerging as a powerful predictor of vascular events, at least in older people. Women on average have lower blood pressure than men. However, blood pressure rises around/following the menopause, indicating that ovarian hormones, especially oestrogen, have a protective effect. Drug treatment of hypertension becomes warranted when the absolute annual risk of cardiovascular events is greater than 2% or where there is severe elevation of blood pressure (Williams *et al.*, 2004; Jessani *et al.*, 2006). It also takes several years for the full effects of blood pressure lowering treatments to have their maximal effects, as was demonstrated in the ALLHAT study (ALLHAT Investigators, 2002). A high proportion of the population has "pre-hypertension" or "mild hypertension" where the

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