Hypertension

Hypertension is a major risk factor for cardiovascular disease, including coronary heart disease and stroke, as well as for end-stage renal disease and peripheral vascular disease. The World Health Organization estimates that nearly one-third of worldwide deaths are due to hypertension.[1] Hypertension, obesity, insulin resistance, and lipid abnormalities (hypertriglyceridemia and low HDL-cholesterol levels) make up the metabolic syndrome, a particularly virulent risk profile for cardiovascular disease.

About 78 million people in the United States have hypertension. Because it is typically asymptomatic, affected individuals often do not know they have the condition. In fact, 20% of hypertensive persons are unaware of their disease, and only about half of those who are aware achieve adequate blood pressure control.[2]

The vast majority of cases are referred to as primary or “essential,” meaning that no specific cause has been identified (although diet, obesity, and other controllable factors contribute to “essential” hypertension). Approximately 5%-10% of cases are “secondary,” that is, they have an identifiable contributing factor, such as renal or renovascular disease, endocrine pathology, obstructive sleep apnea, or prescription and over-the-counter medications.

Although hypertension usually is without signs or symptoms, severe cases may be marked by headache, vision changes, and nausea and vomiting.

Risk Factors

African-Americans have a higher prevalence of hypertension compared with African blacks and North American whites (including Latinos).

The following factors increase the likelihood of developing hypertension:

Age. About two-thirds of Americans over age 65 have high blood pressure.

Family history. As much as 30% of variation in blood pressure may be a consequence of genetic factors.

Obesity. The prevalence of hypertension in obese adults is doubled, compared with individuals near their ideal weight. In addition, overweight is often associated with sleep apnea, which is also associated with increased risk of hypertension.

Lack of exercise. In Western populations, physical inactivity contributes an estimated 5%-13% of the risk for hypertension.[3] Moreover, worldwide it is estimated that 6% of the burden of heart disease (of which hypertension is a major risk factor) is attributable to physical inactivity.[4]

Dietary factors are discussed in Nutritional Considerations below.

Renovascular/kidney disease.

Endocrine disease. Hyperaldosteronism, thyroid disorders, hyperparathyroidism, Cushing syndrome, and pheochromocytoma (rare) are among the endocrine causes of hypertension.

Alcohol excess.

Medications. Corticosteroids, nonsteroidal anti-inflammatory drugs (NSAIDs), antihistamines, diet pills, oral contraceptives, and some antidepressants can increase blood pressure.

Diagnosis

Sustained and untreated high blood pressure may lead to end-organ damage, including coronary heart disease and left ventricular hypertrophy, heart failure (hypertension is the leading cause in developed countries), stroke, retinopathy, and kidney disease. Therefore, early diagnosis and treatment are important.

Normal blood pressure is defined as less than 120/80 mm Hg. Prehypertension is defined as a blood pressure between 120/80 and 139/89 mm Hg. Prehypertension indicates increased risk for progression to hypertension and requires regular monitoring. Hypertension is defined as an average seated blood pressure measurement of 140/90 mm Hg or greater during at least three office visits. Stage 1 hypertension is defined as a systolic blood pressure measurement of 140-159 mm Hg or a diastolic measurement of 90-99 mm Hg. Stage 2 hypertension is defined as a systolic measurement greater than 160 mm Hg or a diastolic measurement greater than 100 mm Hg.[5] Although the above categories are defined by the higher systolic or diastolic measurement, systolic pressures correlate more strongly with cardiovascular disease risk.

Severely elevated blood pressure, typically defined as systolic pressure ≥ 180 mm Hg or diastolic pressure ≥ 120 mm Hg, can lead to end-organ dysfunction, such as retinopathy, encephalopathy, or nephropathy. Hypertension, accompanied by evidence of end-organ dysfunction is termed hypertensive emergency and requires blood pressure lowering within minutes to hours. Evidence of end-organ damage can rapidly develop in patients with previously normal blood pressure. Severely elevated blood pressure without any evidence of end-organ damage is termed hypertensive urgency and requires blood pressure lowering over hours to days in an outpatient setting.[6]

Diagnostic evaluation should consider possible causes of hypertension and its sequelae. Abnormal history or physical examination findings should guide cost-effective testing. Routine laboratory testing and procedures include an electrocardiogram, lipid profile, urinalysis, hematocrit, and a basic metabolic panel. Lipid goals are based on a cardiovascular risk factor assessment.

Children with hypertension should be evaluated for coarctation of the aorta or renal pathology.

Treatment

According to the Eighth Joint National Committee (JNC 8), goal blood pressure for individuals older than 60 with hypertension is less than 150/90 mm Hg. Goal blood pressure for those younger than 60 or those with diabetes or chronic kidney disease is 140/90mm Hg.[7]

Prehypertension usually does not require drug therapy unless the patient has coronary heart disease, diabetes, heart failure, chronic kidney disease, history of stroke, or other end-organ damage. Lifestyle interventions should be instituted for prehypertension, and the patient should monitor blood pressure at regular intervals.

Lifestyle modifications are an integral initial step in the treatment of hypertension. These may include a low-sodium, low-fat diet (particularly a low-fat vegan diet, as noted below), maintenance of appropriate body weight, reduction in alcohol use, increased physical activity, and possibly stress reduction (e.g., through meditation or yoga). Energy expenditure in the form of moderate to vigorous activity reduces risk of hypertension by 10%-20%.[8] Even walking and leisure-time physical activity also lowers the risk for developing hypertension.[9] Smoking cessation does not treat hypertension but should be encouraged for cardiovascular and other health-risk reduction.

Pharmacologic therapy includes several drug choices. Individuals with inadequate response to single-drug treatment often respond to another drug class. However, most patients require at least 2 drugs to achieve target blood pressure, and the use of 3 or more drugs is common.

A thiazide diuretic, calcium channel blocker or ACE inhibitor (ACEI), or ARB is usually prescribed as first-line pharmacotherapy in the general nonblack population, including those with diabetes. For black patients, including those with diabetes, a thiazide or calcium channel blocker (CBB) is the usual first-line treatment.[7]

Racial differences in response to hypertensive therapy have been noted. In black patients, a calcium channel blocker was found to be more effective at controlling blood pressure than an ACEI. In addition, regardless of the presence or

absence of diabetes, a thiazide resulted in improved cardiovascular outcomes compared to an ACEI, and the risk of stroke is significantly reduced with use of a calcium channel blocker, compared with an ACEI.[10] ,[11]

Specific details of each drug class are listed below. Drugs from these classes can be used alone (for specific protective functions) or in combination.

Thiazide diuretics are inexpensive. They tend to reduce calciuria, an effect that may be beneficial for those at risk for osteoporosis and calcium stones. Thiazides may increase blood glucose and lipids.

Angiotensin-converting enzyme (ACE) inhibitors are advantageous in patients after myocardial infarction and in those who have proteinuria or systolic heart failure. They may also be advantageous in diabetes. Side effects include cough, hyperkalemia, and, rarely, angioedema. ACE inhibitors are contraindicated in pregnant women.

Beta-blockers serve as optimal treatment after myocardial infarction. They are also used for systolic heart failure, atrial fibrillation, and angina, and they are safe in pregnancy. However, beta-blockers should be avoided in patients with reactive airway disease or second-degree or third-degree heart block. Erectile dysfunction is a common side effect.

Angiotensin receptor blockers (ARBs) have benefits similar to those of ACE inhibitors. Patients with side effects from ACE inhibitors may be switched to ARBs. These two classes should not be combined as doing so increases the risk for adverse effects and has not been shown to improve mortality. Like ACE inhibitors, ARBs may cause hyperkalemia and are contraindicated in pregnancy.

Calcium channel blockers help protect against angina. Non-dihydropyridine calcium channel blockers may be used for heart rate control. Calcium channel blockers may cause pedal edema and/or conduction abnormalities.

Alpha-adrenergic blockers (e.g., tamsulosin) are indicated in patients with concomitant benign prostatic hyperplasia because of their vasodilatory action on both blood vessels and prostatic smooth muscle. They are associated with risk of postural hypotension but are safe in pregnancy.

Arterial vasodilators include specific drugs that have noteworthy side effects. Hydralazine may cause lupus syndrome, but it is safe in pregnancy.

Minoxidil may cause sodium (i.e., water) retention. It can also cause some degree of hair regrowth, which may be advantageous in balding men.

Potassium-sparing diuretics are optimal for patients at risk of hypokalemia. However, close monitoring of potassium levels is required.

People with hypertension often have lower melatonin levels, compared with those with normal blood pressure,[12] and some fail to experience the normal nocturnal decrease in blood pressure.[13] Although melatonin supplementation may lead to lower nocturnal blood pressures, it is not currently recommended, due to a lack of data showing improved outcomes.

Nutritional Considerations

Nutritional factors play a large role not only in reducing the risk that hypertension will occur, but also in managing the condition after it has been diagnosed. The Dietary Approaches to Stop Hypertension (DASH) studies showed that diets rich in fruits and vegetables and reduced in saturated fat can both lower the risk for high blood pressure and assist with blood pressure control in hypertensive persons.[14] ,[15] The DASH study was predicated on the observation that vegetarian diets are associated with markedly reduced risk of hypertension. Vegetables and fruits accounted for approximately half of the blood-pressure-lowering effect of the diet.

Restricting sodium intake enhanced the blood-pressure-lowering effect. While the DASH diet reduced systolic blood pressure by 5-6 mm, individuals eating the DASH diet in combination with the lowest sodium intake (1200 mg/day)

had a further blood pressure decrease of 5-8 mm Hg.[16]

Some investigators have carried these observations a step further. Vegetarian and vegan diets reduce blood pressure in both normotensive and hypertensive individuals and have the potential to reduce or eliminate medication use in some patients.[17] Possible mechanisms underlying these results may include a combination of the following:

Weight loss reduces blood pressure. A Cochrane review of 8 randomized controlled trials reported that participants following weight-reduction diets reduced their blood pressure by a mean of 4.5 mm Hg systolic and 3.2 mm Hg diastolic.[18] Although a reduction in plasma volume is the most likely reason, this effect may also be in part due to a 15% lower activity of angiotensin-converting enzyme (ACE) after weight loss.[19]

Reducing or eliminating meat may influence blood viscosity. Numerous studies have linked beef, veal, lamb, poultry, and animal fat to high blood pressure.[20] ,[21] ,[22] ,[23] Saturated fat appears to influence blood viscosity.[24] A prospective study found that vegetarians, especially vegans, have lower blood pressure, even when BMI is controlled for.[25]

Increasing potassium intake. Potassium is an electrolyte that reduces blood pressure and stroke risk through improved vasodilation.[26] ,[27] Beet greens, Swiss chard, spinach, potatoes, tomato paste, and adzuki beans are excellent sources.

Emphasizing nitrate-rich vegetables. Evidence suggests that some vegetables may lower blood pressure by providing antioxidant flavonoids that up-regulate endothelial nitric oxide production[28] ,[29] and by suppressing enzymes involved in the generation of superoxide radicals that are known to reduce nitric oxide availability.[30] Arugula is especially nitrate-rich; cilantro, rhubarb, butterleaf lettuce, and other leafy greens are also excellent sources.

Drinking tea. Hibiscus tea, which is rich in antioxidants and anthocyanins, reduced systolic blood pressure by a mean of 7.6 mm Hg and diastolic pressure by 3.5 mm Hg in a meta-analysis of 5 randomized control trials.[31] Another meta-analysis with green and black tea found long-term (> 12 weeks) consumption significantly reduced systolic and diastolic pressure.[32]

Choosing whole grains. A randomized controlled study with healthy individuals found that 3 servings of whole grains reduced systolic and diastolic pressure by 6 mm Hg and 3 mm Hg, respectively.[33] Large prospective studies support the evidence that whole grain consumption reduces blood pressure and hypertension risk.[34]

Plant-based foods are low in sodium.[35] Hypertension is rare in societies whose dietary sodium intake is very low.[36] A 2004 meta-analysis of contributors to hypertension in Finland, Italy, the Netherlands, the United Kingdom, and the United States found that 9%-17% of the risk for hypertension was attributable to dietary sodium alone.[37] In a recent meta-analysis, sodium restriction reduced systolic blood pressure by 3.6 mm Hg.[18] The principal sources of sodium are canned foods, snack foods, discretionary use of salt in food preparation or consumption, and dairy products. In their natural state, vegetables, fruits, grains, and legumes are very low in sodium.

Replacing animal protein with soy and other plant proteins may help lower blood pressure. Plant proteins are higher in L-arginine (an amino acid involved in production of nitric oxide) compared with animal protein, and intake of vegetable (not animal) protein is inversely related to blood pressure.[38] A number of studies have found that soy protein supplementation reduced blood pressure significantly (~5-8 mm Hg systolic, ~2.5-5.0 mm Hg diastolic) in both normal and hypertensive individuals.[39]

Additional considerations in preventing or controlling hypertension include:

Limiting alcohol. In excess of moderate consumption (1-2 drinks/day), alcohol intake raises the risk for developing hypertension.[40]

Folic acid. The Nurses' Health Study found that women consuming the highest amounts of folate from diet and supplements (≥ 1000 µg per day) had only one-third the risk for developing hypertension, compared with women consuming less than 200 µg per day.[41] One possible explanation is that folate is an important cofactor for nitric

oxide synthase and subsequent nitric oxide generation.

Vitamin C. A diet that meets the Dietary Reference Intake (DRI) for vitamin C may not be adequate in persons at risk for hypertension. Studies show that blood pressure rises as vitamin C depletion occurs in humans,[42] and higher vitamin C intakes are associated with lower blood pressure.[43] However, there do not appear to be any additional blood pressure-lowering effects of vitamin C over an intake of 500 mg per day.[44]

Magnesium. Magnesium helps moderate blood pressure, competes with sodium for binding sites on vascular smooth muscles cells, and reduces endothelial dysfunction in hypertensive patients.[40] Some studies have shown that magnesium intake is inversely associated with blood pressure[41] and could play a significant role in prevention.[42] , [45] The Women's Health Study of more than 28,000 women found that the highest magnesium intakes (434 mg/day) were associated with a 7% lower risk for developing hypertension, compared with intakes of 256 mg/day.[46] Evidence on the efficacy of supplementation is mixed[47] ,[48] ,[49] though magnesium appears to be most beneficial when combined with a high-potassium, low-sodium diet.[49] Spinach, Swiss chard, and legumes are low-sodium, high-potassium sources of magnesium.

Orders

Sodium less than 2g daily.

Smoking cessation and alcohol restriction, if applicable.

Individualized exercise prescription, as appropriate.

What to Tell the Family

Hypertension usually has no symptoms but can be deadly. It is important for the patient and the family to have their blood pressure checked regularly and to adhere to the prescribed treatment plan. A good-quality home blood pressure monitor provides a convenient means of tracking hypertension and progress with treatment.

Hypertension is not treated with medication alone. Dietary and lifestyle changes can significantly help reduce blood pressure and can reduce, sometimes even eliminate, the need for medication. The family can support and enhance the patient's adherence to the recommended diet. Because weight problems and hypertension often run in families, it is important for the entire family to shift to healthier eating and exercise patterns. Smoking cessation and alcohol restriction should be encouraged.

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