CME Geriatrics The Heart

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# Hypertension
## Contemporary challenges in geriatric care

**George C. Francos, MD • Henry L. Schairer, Jr., MD**

**Hypertension has been unequivocally linked to morbid complications such as heart attack, congestive heart failure, renal failure, and stroke. Despite the availability of myriad effective antihypertensive agents, blood pressure remains either untreated or inadequately controlled to even conservative goals in many patients. Only 68.4% of hypertensive individuals are aware of their condition, only 53.6% are under treatment, and nearly 75% fail to reach the recommended target pressure of 140/90 mm Hg. Significantly, only 40 to 50% of hypertensives will be controlled on a single agent, while most patients with more severe hypertension will require 3 or even 4 agents. This article reviews the overall approach to the hypertensive patient, with special emphasis on target blood pressures in special populations and problems frequently encountered in the older patient.**

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**Key words:** Hypertension • Antihypertensives • Pulse pressure

In 1945, history took an unexpected turn when Franklin D. Roosevelt died of a cerebral hemorrhage at age 63, the result of hypertension, for which there was little effective treatment at the time.[1] Today, incidences of stroke, congestive heart failure (CHF), renal disease, and coronary heart disease (CHD) have been dramatically impacted by antihypertensive medications, all of which were developed in the last half of the 20th century. Had modern antihypertensive agents been available in Roosevelt's day, he likely would have survived the fourth presidential term to which he'd been elected, and the post-war world may have been very different.

Yet, despite the known impact of antihypertensive therapy on cardiovascular morbidity and mortality, only 68.4% of today's hypertensive patients are aware of their condition, only 53.6% are under treatment, and approximately 75% fail to reach the recommended pressure of 140/90 mm Hg.[2] Consequently, age-adjusted rates for stroke have increased slightly in recent years, and the decline of CHD seems to be leveling.[2] The incidence of end-stage renal disease is also rising, and hypertension and CHF have been definitively linked. It is obvious, then, that physicians must become more aggressive in the treatment of hypertension, including hypertension in older adults.

This article reviews the evaluation and treatment of primary, or essential, hypertension. Clinical features atypical of essential hypertension should raise the possibility of secondary hypertension. Such indicators include age at onset in the sixth decade (or before the third decade of life), worsening of previously well-controlled blood pressure, hypokalemia, or renal insufficiency. Chronic kidney disease is by far the most common cause of secondary hypertension, followed by renal vascular disease, primary hyperaldosteronism, and rarely hypercalcemia, pheochromocytoma, and Cushing's disease. Secondary hypertension is an important issue but is outside the scope of this discussion.

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### Defining hypertension

Whereas stage 1 hypertension in those age 18 and older is defined as a systolic

pressure greater than or equal to 140 mm Hg, or as a diastolic pressure greater than or equal to 90 mm Hg,[3] today's standards of care emphasize treating those with sub-optimal blood pressure (table 1). Optimal blood pressure is defined as less than 120 mm Hg systolic and less than 80 mm Hg diastolic. "Normal" blood pressure is less than 130/85, whereas high normal is defined as 130-139/85-89. Those with sub-optimal, but still normal, blood pressure should be rechecked in 2 years, whereas those with high normal blood pressure should be rechecked in 1 year and adopt lifestyle modifications.


## Target treatment goals

Traditionally, target blood pressure for those receiving pharmacotherapy was 140/90 mm Hg. More recent epidemiologic data, however, suggests that this goal may be too liberal. In a sample of 6,859 subjects from the Framingham Heart Study, the cumulative incidence rates of a first cardiovascular event (death due to CVD, MI, stroke, or CHF) increased in a graded fashion across the three blood pressure strata of optimal, normal, and high normal.[4] Alternatively, the enthusiasm to treat all hypertensives to "optimal" levels has been tempered by conflicting evidence indicating that there may be a threshold below which further blood pressure reduction is deleterious (the J-shaped curve). This concern is based on the physiologic principle that coronary filling occurs primarily during diastole and that coronary hypoperfusion may follow if diastolic pressures are greatly reduced in patients with left ventricular hypertrophy or CAD. If the controversial J-shaped curve truly exists, then primary care physicians must exercise extreme caution when aggressively treating hypertension in older adults.

**The J-shaped curve:** The data does show that many patients benefit from lower than the traditional target of 140/90 mm Hg. A systematic review of 13 studies including more than 48,000 subjects clearly demonstrated a J-shaped relationship between treated diastolic blood pressure and the incidence of cardiovascular events: Low treated diastolic blood pressure levels, ie, below 85 mm Hg, are associated with increased risk of cardiac events.[5]

There is, however, strong evidence refuting, or at least minimizing the importance of the J-curve hypothesis. For instance, the Department of Health Hypertension Care Computing Project (DHCCP) failed to demonstrate a J-shaped curve after 54,000 patient-years of follow up.[6] The MRFIT trial (following 5,362 men with history of MI for 16 years) reported high mortality in the short term (2 years) in those with diastolic blood pressures below 70 mm Hg.[7] However, long term the advantage favored those with diastolic pressures between 70 and 89 mm Hg. Flack and colleagues hypothesize that low diastolic blood pressures may be a marker of myocardial damage (or other underlying co-morbid condition) rather than a cause of it, and conclude that all hypertension should be carefully but aggressively treated in the geriatric population. The rationale is that lower pressures (eg, 135/60 mm Hg) are better than mixed pressures (eg, 170/85 mm Hg) because low diastolic reflects damaged myocardium which is best protected by hypertension control.

The HOT trial, which included nearly 19,000 patients from 26 countries, was designed to settle the controversy over the existence of a J-shaped curve in patients with both systolic and diastolic hypertension.[8] Subjects were randomized to three diastolic blood pressure goal groups: ≤ 90, ≤ 85, or ≤80 mm Hg. Patients with isolated systolic hypertension were excluded. Less disparity in the attained treated diastolic blood pressures than planned made conclusions regarding the J-shaped curve somewhat equivocal. Nevertheless, there was a definite tendency toward a beneficial effect of lowering diastolic pressure below the low to mid 80's, and there was no harm in going lower. Diabetics especially seemed to benefit. Somes et al examined Systolic

**Table 1 Classification of blood pressure for adults age 18 and older***

| | Systolic (mm Hg) | | Diastolic (mm Hg) |
|---|---|---|---|
| Optimal | <120 | AND | <80 |
| Normal | <130 | AND | <85 |
| High Normal | 130-139 | OR | 85-89 |
| Hypertension | | | |
| Stage 1 | 140-159 | OR | 90-94 |
| Stage 2 | 160-179 | OR | 100-109 |
| Stage 3 | ≥180 | OR | ≥110 |

*Adapted from The sixth report of the Joint National Committee on the prevention, detection, evaluation, and treatment of high blood pressure. National High Blood Pressure Education Program, National Heart, Lung, and Blood Institute, National Institutes of Health. November 1997.

Hypertension in the Elderly Program (SHEP) data to determine whether a treated reduction in diastolic pressure was associated with an increase in event risk among older patients with isolated systolic hypertension. Although diastolic blood pressures ≤70 mm Hg were associated with a significant risk of stroke and other cardiovascular events and pressures ≤55 mm Hg approached a 2-fold increase in risk, participants who were actively treated did not have worse outcomes than those who received placebo.[9]

**In practice, when treating patients at average cardiovascular risk, aim for a blood pressure less than 140/90 mm Hg.** Monitor regularly, at least in the first 2 months, to avoid inadvertent lowering of the diastolic blood pressure below 65-70 mm Hg, particularly in older patients with isolated systolic hypertension.

## Special Populations

While general guidelines are applicable to the majority of primary care patients, certain populations require more aggressive care. For example, African-American patients experience more renal injury than Caucasians for a given degree of hypertensive insult. It may be incremental subclinical injury over time that leads to the high incidence of so-called "salt-sensitive" hypertension seen in this racial group. Satisfaction with "high-normal" blood pressure goals may, in fact, do this patient population a disservice. **When treating African-American hypertensives, aim for blood pressures in the normal or even optimal range.**

Patients with both type 1 and type 2 diabetes mellitus are at especially high risk of cardiovascular complications and renal deterioration. Data from the 1980s demonstrate a synergistic risk of developing end-stage renal disease in diabetic patients who are also hypertensive. In a randomized controlled trial of 1,148 hypertensive type 2 diabetics, patients assigned to tight blood pressure control versus less tight control (mean blood pressures of 144/82 mm Hg compared with 154/87 mm Hg, respectively) experienced significant reductions in diabetic end points, diabetes-related deaths, and microvascular end points over a median of 8.4 years of follow up.[10] Guidelines support more aggressive antihypertension goals in this population: **When treating hypertensive type 2 diabetic patients, aim for blood pressures ≤130/80 mm Hg.**[10, 11]

An aggressive anti-hypertensive strategy is also important in patients with other proteinuric nephropathies. The Modification of Diet in Renal Disease Study Group trial was designed to determine the effect of stringent blood pressure control on the progression of chronic renal failure. Examination of more than 5,800 patients with proteinuric renal disease demonstrated that more stringent blood pressure control had a favorable impact on the progression of renal dysfunction and cardiovascular events.[12] **When treating patients with chronic renal insufficiency and proteinuria of at least 1 g/day, aim for blood pressures ≤125/75 mm Hg.**

## Geriatric considerations

Due to the loss of distensibility in large atherosclerotic vessels, systolic blood pressure tends to rise with advancing age while the diastolic blood pressure tends to fall.[2] Whereas diastolic hypertension is generally recognized in younger patients along with concert systolic hypertension, the emerging clinical challenge in a growing number of older adults is isolated systolic hypertension. The choice of pressure index that is most predictive of cardiovascular risk may change with age: At younger ages, diastolic pressure appears to be the superior index; with aging, however, systolic pressure becomes the more important index. With advancing age, systolic pressure remains important, diastolic pressure becomes negatively predictive, and pulse pressure—the difference between systolic and diastolic readings, normal range is 30 to 40 mm Hg—assumes a greater role. In a recent meta-analysis examining nearly 8,000 patients, Blacher et al showed that pulse pressure is the most informative index of cardiovascular risk in older adults. The investigators found that a 10-mm Hg widening in pulse pressure increased the risk for major cardiovascular events by 13% and cardiovascular mortality by 20%.[13]

Although pulse pressure is now recognized as an important variable, clinically relevant manipulation of the pulse pressure with drug therapy has yet to be demonstrated. In contemporary clinical practice, systolic pressure often becomes the target of therapy. The SHEP was one of the first to show that antihypertensive pharmacologic therapy in patients age 60 and older with isolated systolic hypertension could positively impact the risk of stroke and secondary cardiovascular endpoints.[14] A systematic review of 8 trials including more than 15,000 patients age 60 and older showed that antihypertensive medications reduced total mortality by 13%, stroke by 30%, and coronary events by 23%.[15]

In summary, pulse pressure appears to be the primary determinant of cardiovascular risk in those age 60 and older. However, for practical purposes, systolic blood pressure remains the clinical target because of its contribution to morbidity and mortality in aging patients. Aggressive treatment of systolic hypertension can modulate this risk, but care must be taken not to inadvertently lower diastolic pressures to levels that could be detrimental. Treatment always begins with lifestyle modifications, but to achieve target blood pressures, multi-drug therapy is often necessary in more than 50% of patients.

## Lifestyle modifications

Necessary lifestyle modifications include weight loss, limiting alcohol ingestion, salt restriction, smoking cessation, as well as daily physical activity and maintenance of adequate dietary potassium and calcium.

**Weight loss.** Excess body weight, as evidenced by a waist circumference of ≥34 inches in women or ≥39 inches in men, correlates with increased blood

pressure. Weight loss of as little as 10 pounds can reduce blood pressure in overweight persons with hypertension by enhancing the blood–pressure-lowering effect of antihypertensive agents. The JNC recommends placing all hypertensives above desirable weight on individualized, monitored weight reduction programs that involve caloric restriction as well as increased physical activity (see below).[3]

**Alcohol intake.** Excessive alcohol intake is not only a risk factor for hypertension, but can also lead to drug resistance, thus exacerbating already difficult-to-treat medical conditions.[16] *Modest* alcohol consumption (defined below), however, has cardioprotective effects related in part to beneficial changes in high-density lipoprotein cholesterol (HDL).[17] Weighing alcohol risks against benefits of modest ingestion, current recommendations are that alcohol consumption be limited to no more than 1 oz. ethanol in men and 0.5 oz. in women per day. One ounce of alcohol corresponds approximately to two bottles of beer, two 5-oz. glasses of wine, or one hard drink per day (2 oz. 100-proof of liquor).[18]

**Salt restriction.** Though difficult to maintain for long periods in industrialized cultures, salt restriction can have a significant impact on hypertension control in certain patient populations. Older age is associated with increased salt sensitivity and African Americans frequently have salt-sensitive hypertension that responds, at least partially, to salt restriction. Although weight loss alone lowers blood pressure in the overweight, salt restriction in conjunction with weight loss has an even greater impact.[19]

Excessive sodium intake can thwart antihypertensive pharmacotherapy. Diuretic therapy depends on initial natriuresis, and excess dietary sodium blunts blood pressure response. angiotensin-converting enzyme (ACE) inhibitor therapy is aided by salt restriction, as is the proteinuric effect of converting enzyme inhibitors.[20]

The U.S. Dietary Guidelines recommend a daily sodium intake of 2,400 mg (approximately 1 teaspoon of salt). Americans typically consume approximately 170 mmol sodium (4 g) daily. The JNC recommends that hypertensive individuals restrict sodium intake to 100 mmol (2.3 grams) sodium daily. As a practical matter, it is important not only to remind patients about table salt, but also to counsel avoidance of salt-rich foods, such as processed luncheon meats, fast foods, canned soups, and frozen dinners. Remind patients to read nutrition labels.

**Smoking cessation.** Because blood pressure rises with each cigarette smoked, the JNC recommends that smokers be told repeatedly to stop smoking. Smoking cessation aids contain minimal amounts of nicotine that do not interfere with antihypertensive medications and therefore may be used with necessary counseling and behavioral interventions.

**Physical activity.** The JNC notes that blood pressure can be lowered with moderately intense physical activity, such as 30 to 45 minutes of brisk walking most days of the week. Whereas most individuals can safely increase their phsyical activity level without medical evaluation, patients with cardiac problems need a thorough evaluation that may include a cardiac stress test and even referral to a specialist.

**Potassium and calcium intake.** Adequate dietary intake of potassium (90 mmol per day) and calcium, preferably from fruits, vegetables, and dairy products (see table 2), is associated with improved hypertension.[3]

## Table 2 Dietary sources of potassium and calcium

**Foods high in potassium**

| | | | | |
|---|---|---|---|---|
| Apricots | Carrots | Cress (water) | Parsley | Spinach |
| Asparagus | Celery | Cucumber | Parsnips | Squash |
| Bamboo shoots | Chard (Swiss) | Kohlrabi | Pumpkin | Tomatoes |
| Beet greens | Chives | Molasses | Radishes | Turnips |
| Broccoli | Collards | Mushrooms | Rhubarb | |
| Cabbage | Cress (garden) | Okra | Seaweeds | |

**Foods high in calcium**

**Dairy**

| | | |
|---|---|---|
| Non-fat milk | Reduced fat milk | Nonfat yogurt |
| Swiss cheese | Mozzarella, part skim | American cheese |
| Cottage cheese | Parmesan cheese,grated | Pudding, prepared |
| Frozen yogurt | Ice cream, light | |

**Non-dairy**

| | | |
|---|---|---|
| Black beans | Navy Beans | Fortified cereal |
| Soybeans, cooked | Spinach | Bok choy |
| Kale | Corn tortilla | Greens, mustard |
| Fortified orange juice | Canned salmon w/bones | Soy milk, fortified |
| Tofu | Almonds | Oysters |

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## Medication selection

Beta blockers and thiazide diuretics have a proven track record of reducing morbidity and mortality from hypertension, and thus some consider them initial pharmacotherapy choices.

Side effects of diuretics (hypokalemia, hyperglycemia, hyperuricemia) are minimized by using low doses (eg, 12.5-25 mg/d hydrochlorothiazide). Diuretics significantly improve the efficacy of most other antihypertensive agents, especially beta-blockers, ACE inhibitors, and adrenergic inhibitors.[21] There is, how-

**Table 3 Antihypertensive Tx for targeted disorders**

| |
|---|
| **Diabetic/proteinuric renal diseases** |
| • ACE inhibitors |
| • angiotensin receptor antagonists |
| **Heart failure** |
| • diuretics |
| • beta blockers |
| • ACE inhibitors |
| • angiotensin receptor antagonists |
| **Isolated systolic hypertension** |
| • diuretics |
| • dihydropyridine calcium channel antagonists |
| **MI** |
| • beta blockers |
| • ACE inhibitiors (with systolic dysfunction) |

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ever, evidence-based rationale for the prescription of certain drug classes in specific population groups— in particular, systolic hypertension in older adults, diabetics with proteinuria, patients with MI, or those with CHF (table 3).

**Systolic hypertension.** SHEP examined the effects of chlorthalidone with the possible addition of atenolol, methyldopa, or hydralazine on 4,736 patients with systolic pressure ≥160 mm Hg and diastolic pressure ≤90 mm Hg.[14] Compared with placebo, stroke risk was reduced by 33% in actively treated patients. In addition, there was a 50% reduction in CHF, and an overall 27% reduction in cardiovascular endpoints.

**Diabetic patients.** Antihypertensive therapy in general has a beneficial effect on patients with type 1 diabetes and renal disease, and ACE inhibition in particular offers even greater protection for this group. Not only do type 1 diabetics with overt proteinuria and renal dysfunction have a slower renal deterioration with ACE inhibition, but also those who are normotensive with microalbuminuria benefit from ACE inhibitors.[22,23]

The beneficial effects of disrupting the renin-angiotensin system have been extended to type 2 diabetics with renal disease. The Irbesartan Diabetic Nephropathy trial demonstrated the greater effectiveness of this angiotensin receptor blocker (ARB) compared with amlodipine in the combined endpoint of doubling serum creatinine, death from any cause, or onset of end-stage renal disease.[24] The ACE inhibitor ramipril was effective in preventing the development of overt nephropathy in type 2 diabetics.[25]

In all diabetic patients, the primary goal is a blood pressure in the normal to optimal strata. If possible, an ARB or ACE inhibitor should be included in the regimen for reasons discussed below. However, merely prescribing these drugs is not enough. Achieving target blood pressure may require other agents, especially diuretics in those with renal insufficiency. Thiazide diuretics are generally not effective in those with a creatinine clearance less than 30 mL/min or serum creatinine greater than 2.5 mg/dL, necessitating the use of loop diuretics in patients with moderate or severe renal insufficiency.

**Myocardial infarction.** Left ventricular function and long-term survival after MI was improved in patients who were administered an ACE inhibitor within days of MI, especially those who have initially a reduced left ventricular ejection fraction.[26] Beta blockade is likewise known to improve MI outcomes.[5]

**Heart failure.** Patients with heart failure deserve special consideration. These patients have high levels of circulating catecholamines, renin, and angiotensin. Patients with severe or mild heart failure benefit from ACE inhibitors with a decrease in mortality.[27] Although there is not a wealth of experience compared with ACE inhibitors, ARB use in heart failure seems to confer similar benefit.[28] ACE inhibitors in black patients with heart failure, however, may not confer the same benefit as with Caucasians.[29] Beta blockers without intrinsic sympathomimetic activity likewise improve outcomes, including mortality, in patients with heart failure. Typically then, diuretics—the backbone of therapy in heart failure patients—are supplemented with ACE inhibitors or ARB's, and often beta blockade.

Patients with severe left ventricular dysfunction, especially those with even mild renal insufficiency, are prone to acute exacerbations of azotemia and hyperkalemia with interruption of the renin-angiotensin system. Thus, ACE inhibitor or ARB dosage should at first be low in these patients (eg, 2.5 mg/d enalapril or 25 mg/d losartan potassium). Similarly, to avoid worsening heart failure or hypotension, beta blockade should begin with low doses (eg, 3.125 mg/bid carvedilol or 12.5 mg/bid metoprolol).

## Conclusion

Modern antihypertensive agents are strikingly effective in prolonging life not only in patients with uncomplicated hypertension, but also in those with a wide range of comorbidities, such as diabetic renal disease and heart failure. Yet, when confronted with a patient with inadequately controlled hypertension, many physicians simply request more frequent follow-up without medication addition.[30] Only 40 to 50% of hypertensives will be controlled on a single agent, while most patients with more severe hypertension will require 3 or even 4 agents. Dosages in the lower to middle range of therapeutic efficacy for a particular agent tend to provide most of the therapeutic efficacy while minimizing side effects. Primary care physicians can improve overall cardiac outcomes by aggressively treating hypertension—and even "high normal" blood pressures—in all patients. G

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1. Normotensive Type 1 diabetics with microalbuminuria benefit from angiotensin-converting-enzyme inhibitors.
   ☐ a. True ☐ b. False
2. Heart failure patients are often treated with:
   ☐ a. diuretics
   ☐ b. ACE inhibitors
   ☐ c. beta blockers
   ☐ d. all of the above
3. Diuretics potentiate the efficacy of most antihypertensive agents.
   ☐ a. True ☐ b. False
4. The need for dietary sodium restriction is mitigated by diuretic therapy.
   ☐ a. True ☐ b. False
5. The HOT trial unequivocally disproved the concept that there is a threshold blood pressure, below which treatment leads to deleterious effects (eg, a J-curve).
   ☐ a. True ☐ b. False
6. Which of the following statements regarding blood pressure management are true?
   ☐ a. "Salt-sensitive" hypertension is restricted primarily to young patients with no target organ damage.
   ☐ b. Aggressive blood pressure control in type 2 diabetics has not been shown to improve outcomes.
   ☐ c. Patients with proteinuric renal disease should have hypertension treated to a level of 125/75 mm Hg.
   ☐ d. A blood pressure reading consistently between 130-139/85-89 mm Hg is acceptable in an African-American patient.
7. Pulse pressure is now the preferred clinical treatment target index in the elderly population.
   ☐ a. True ☐ b. False
8. Chronic renal disease is the most common cause of secondary hypertension.
   ☐ a. True ☐ b. False

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1. The information presented in this article was useful.
   1 2 3 4 5 6
2. The information presented was fair, objective, and balanced.
   1 2 3 4 5 6

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