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Managing Hypertension in the Elderly: What is Different, What is the Same?

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Abstract
Purpose of Review The goal is to discuss management of hypertension in the elderly.
Recent Findings At 3.14-year follow-up of 2636 persons ≥75 years in the Systolic Blood Pressure Intervention Trial (SPRINT), compared with a systolic blood pressure (SBP) goal of <140 mmHg, a SBP goal of <120 mmHg reduced the primary endpoint of myocardial infarction, other acute coronary syndrome, stroke, heart failure, or cardiovascular death by 34% ($p = 0.001$), all-cause mortality by 33% ($p = 0.009$), heart failure by 38% ($p = 0.003$), and the primary outcome or death by 32% ($p < 0.001$). Absolute cardiovascular event rates were lower for the intensive treatment group within each frailty stratum. The incidence of serious adverse events was similar in both treatment groups.
Summary The SPRINT trial provides very important information on the efficacy and safety of lowering the SBP to <120 mmHg in elderly adults with hypertension.

Keywords Hypertension · Systolic blood pressure · Diastolic blood pressure · Elderly · Cardiovascular events · Antihypertensive drug therapy

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Introduction

Hypertension is the leading modifiable risk factor for cardiovascular events and mortality in the world [1]. Hypertension is a major risk factor for cardiovascular events and mortality in older persons [2]. Hypertension is present in 69% of persons with a first myocardial infarction [3], in 77% of persons with a first stroke [3], in 74% of persons with congestive heart failure [3], and in 60% of older persons with peripheral arterial disease [4]. Hypertension is also a major risk factor for development of sudden cardiac death, a dissecting aortic aneurysm, angina pectoris, left ventricular hypertrophy, thoracic and abdominal aortic aneurysms, chronic kidney disease, atrial fibrillation, diabetes mellitus, the metabolic syndrome, vascular dementia, Alzheimer's disease, and ophthalmologic disease [2]. A meta-analysis of 61 prospective studies including data from 1 million adults without prior cardiovascular disease demonstrated that the cardiovascular risk increases progressively from a blood pressure level of 115/75 mmHg with a doubling of the incidence of coronary heart disease and of stroke for every 20/10 mmHg increase [5]. This review article will discuss the data for prior hypertensive guidelines and current data supporting what the optimal blood pressure goal should be in older persons with hypertension.

Clinical Trials on Treatment of Hypertension in Elderly Persons

Numerous randomized, placebo-controlled trials have demonstrated that antihypertensive drug therapy reduced cardiovascular events in elderly persons with hypertension [2, 6–11]. A meta-analysis was performed in 8 trials of 15,693 persons

aged 60 years and older with treated and untreated isolated systolic hypertension who were followed for a median of 3 to 8 years [11]. Antihypertensive drug therapy lowered all-cause mortality by 13% ($p = 0.02$), cardiovascular death by 18% ($p = 0.01$), cardiovascular events by 26% ($p < 0.0001$), stroke by 30% ($p < 0.001$), and coronary events by 23% ($p = 0.001$) [11]. The number needed to treat for 5 years to prevent 1 major cardiovascular event was 18 men versus 38 women, 19 persons aged 70 years and older versus 39 persons younger than 70 years, and 16 persons with prior cardiovascular disease versus 37 persons without prior cardiovascular disease [11].

The Hypertension in the Very Elderly (HYVET) trial randomized 3845 persons aged 80 years and older (mean age 83.6 years; 60.5% women) with a systolic blood pressure of 160 mmHg or higher to antihypertensive drug therapy or to double-blind placebo [12]. The target blood pressure was 150/80 mmHg, and the lowest systolic blood pressure reached was 143 mmHg. Median follow-up was 1.8 years. The elderly persons randomized to antihypertensive drug treatment had a 30% decrease in fatal or nonfatal stroke ($p = 0.06$), a 39% decrease in fatal stroke ($p = 0.05$), a 21% decrease in all-cause mortality ($p = 0.02$), a 23% decrease in cardiovascular mortality ($p = 0.06$), and a 64% decrease in heart failure ($p < 0.001$) [12].

The REasons for Geographic and Racial Differences in Stroke (REGARDS) study is an observational study of the incidence of stroke in persons living in the stroke belt and stroke buckle regions of the USA [13]. In this study, 4181 persons were aged 55–64 years, 3737 persons were aged 65–74 years, and 1839 patients were aged 75 years and older (mean age 79.3 years) receiving treatment with antihypertensive drugs. The median follow-up was 4.5 years for cardiovascular disease (coronary heart disease or stroke) and coronary heart disease, 5.7 years for stroke, and 6.0 years for all-cause death. For persons aged 55 to 64 years, a systolic blood pressure below 140 mmHg was associated with a reduced incidence of cardiovascular disease, coronary heart disease, stroke, and all-cause death, with the numerically highest incidence of risk at systolic blood pressure levels of 140 to 149 mmHg, and especially at systolic blood pressure levels of 150 mmHg or higher [13]. For persons aged 65 to 74 years, there was an increase in incidence of cardiovascular disease and coronary heart disease at systolic blood pressure levels of 150 mmHg, and higher for stroke at systolic blood pressure levels of 130 mmHg and higher, and for all-cause death at systolic blood pressure levels of 140 mmHg and higher [13]. For persons aged 75 years and older, there was an increase in cardiovascular disease, coronary heart disease, and stroke at systolic blood pressure levels of 140 mmHg and higher [13]. This study concluded that in persons aged 55 years and older treated with antihypertensive drugs, a systolic blood pressure between 120 to 139 mmHg was significantly associated with a decreased risk for cardiovascular events and for all-cause death [13]. The optimal diastolic blood pressure in this study was 70 to 90 mmHg [14].

A post hoc analysis of the Secondary Prevention of Small Subcortical Strokes (SPS3) trial investigated the effects of a systolic blood pressure goal of less than 130 versus 130 to 149 mmHg in 3020 patients, mean age 63 years, with a recent lacunar stroke [15••]. After 1 year, the mean systolic blood pressure was 138 mmHg in 1519 patients and 127 mmHg in 1501 patients. Compared to a systolic blood pressure of 138 mmHg, a systolic blood pressure of 127 mmHg nonsignificantly reduced at 3.7-year follow-up all strokes by 19%, disabling or fatal stroke by 19%, and myocardial infarction or vascular death by 16% and significantly reduced intracerebral hemorrhage by 63% ($p = 0.03$) [15••]. These data support a systolic blood pressure goal of less than 130 mmHg in patients with a lacunar stroke [15••, 16].

The SPRINT randomized 9361 persons with a systolic blood pressure of 130 to 180 mmHg and an increased cardiovascular risk but without diabetes mellitus, history of stroke, symptomatic heart failure within the past 6 months, a left ventricular ejection fraction below 35%, and an estimated glomerular filtration rate below 20 ml/min/1.73 m^2 to a systolic blood pressure goal of less than 120 mmHg or to a systolic blood pressure goal of less than 140 mmHg [17••]. The participants were aged 50 years and older with a mean age of 67.9 years. Of the 9361 participants, 2636 (28.2%) were aged 75 years and older, 3332 (35.6%) were women, 5399 (57.7%) were non-Hispanic whites, 2947 (31.5%) were blacks, and 984 (10.6%) were Hispanics. Cardiovascular disease was present in 1877 persons (20.1%), and the Framingham 10-year cardiovascular disease risk score was 15% and higher in 5737 persons (61.3%).

At 1 year, the mean systolic blood pressure was 121.4 mmHg in the intensive treatment group and 136.2 mmHg in the standard treatment group. The intervention was stopped after a median follow-up of 3.26 years [17••].

The primary composite outcome was myocardial infarction, other acute coronary syndrome, stroke, heart failure, or death from cardiovascular causes and was reduced 25% ($p < 0.001$) by intensive blood pressure treatment [17••] (Table 1). Intensive blood pressure treatment reduced all-cause mortality by 27% ($p = 0.003$), heart failure by 38% ($p = 0.002$) death from cardiovascular causes by 43% ($p = 0.005$), and the primary composite outcome or death by 22% ($p < 0.001$) [17••] (Table 1). Intensive blood pressure treatment nonsignificantly reduced myocardial infarction by 17%, caused the same incidence of other acute coronary syndrome, and nonsignificantly reduced stroke by 11%. Intensive blood pressure treatment significantly lowered the primary outcome by 33% in persons aged 75 years and older and significantly reduced the primary outcome by 20% in persons aged 50 to 74 years [17••].

Serious adverse events were similar in both treatment groups [17••]. However, intensive blood pressure treatment caused more hypotension (2.4 versus 1.4%, $p = 0.001$), more

Table 1 Clinical outcome data from the Systolic Blood Pressure Intervention Trial [17••, 18••]

1. At 3.26-year median follow-up of 9361 persons aged 50 years and older, mean age 67.9 years, with a systolic blood pressure of 130 mmHg to 180 mmHg, compared with a systolic blood pressure goal of less than 140 mmHg, a systolic blood pressure goal of less than 120 mmHg reduced the primary endpoint of myocardial infarction, other acute coronary syndrome, stroke, heart failure, or cardiovascular death by 25% ($p < 0.001$), all-cause mortality by 27% ($p = 0.003$), heart failure by 38% ($p = 0.002$), cardiovascular death by 43% ($p = 0.005$), and the primary outcome or death by 22% ($p < 0.001$) [17••]
2. At 3.14-year median follow-up of 2636 persons aged 75 years and older, mean age 79.9 years, compared with a systolic blood pressure goal of less than 140 mmHg, a systolic blood pressure goal of less than 120 mmHg reduced the primary endpoint of myocardial infarction, other acute coronary syndrome, stroke, heart failure, or cardiovascular death by 34% ($p = 0.001$), all-cause mortality by 33% ($p = 0.009$), heart failure by 38% ($p = 0.003$), and the primary outcome or death by 32% ($p < 0.001$) [18••]

syncope (2.3% versus 1.7%, $p = 0.05$), more electrolyte abnormality (3.1 versus 2.3%, $p = 0.02$), and more acute kidney injury or acute renal failure (4.1 versus 2.5%, $p < 0.001$). The incidence of bradycardia, injurious falls, and orthostatic hypotension with dizziness was similar in both treatment groups [17••].

Of the 2636 persons aged 75 years and older, mean age 79.9 years, in SPRINT, 33.4% of persons randomized to a systolic blood pressure goal of less than 120 mmHg and 28.4% of persons randomized to a systolic blood pressure goal of less than 140 mmHg were frail [18••]. At 3.14-year median follow-up, compared with a systolic blood pressure goal of less than 140 mmHg, a systolic blood pressure goal of less than 120 mmHg reduced the primary endpoint of myocardial infarction, other acute coronary syndrome, stroke, heart failure, or cardiovascular death by 34% ($p = 0.001$), all-cause mortality by 33% ($p = 0.009$), heart failure by 38% ($p = 0.003$), and the primary outcome or death by 32% ($p < 0.001$) (Table 1). Absolute cardiovascular event rates were lower for the intensive treatment group within each frailty stratum. The incidence of serious adverse events was similar in both treatment groups. However, intensive blood pressure lowering nonsignificantly increased hypotension, syncope, electrolyte abnormalities, and acute kidney injury [18••].

Overall, 16.8 million US adults and 8.2 million US adults with treated hypertension meet the Sprint eligibility criteria [19]. The SPRINT eligibility criteria were applied to the 1999 to 2006 National Health and Nutrition Examination Survey and linked with the National Death Index through December, 2011 [20••]. This study reported that intensive lowering of systolic blood pressure of all eligible US adults could prevent 107,500 deaths per year and 46,100 cases of heart failure per year but cause an increase in serious adverse events [20••].

The Heart Outcomes Prevention Evaluation (HOPE)-3 trial randomized 12,705 persons (49% Asians, 20% whites, 27% Hispanics, and 2% blacks), mean age 65.7 years, without cardiovascular disease and at intermediate risk to treatment with candesartan 16 mg plus hydrochlorothiazide 12.5 mg daily or to placebo [21]. The baseline mean blood pressure was 138.1/81.9 mmHg. The decrease in blood pressure in the drug treatment group was 6.0/3.0 mmHg. At 5.6-year median follow-up, there was no significant reduction in the composite endpoint of cardiovascular death, nonfatal myocardial infarction, or nonfatal stroke. In the subgroup of patients with a systolic blood pressure higher than 143.5 mmHg, drug therapy reduced the composite endpoint of cardiovascular death, nonfatal myocardial infarction, or nonfatal stroke by 27% (95% CI, 6 to 44%) [21].

Less than 40% of the persons in the HOPE-3 trial had hypertension, and the risk for cardiovascular disease was much lower in the HOPE-3 trial than that in SPRINT [22]. The systolic blood pressure reduction in SPRINT was 14.8 mmHg lower with intensive treatment than with standard treatment, whereas the systolic blood pressure was reduced only 6 mmHg by drug therapy in the HOPE-3 trial [22]. Chlorthalidone was used in SPRINT and has been shown to reduce cardiovascular events in clinical trials, whereas hydrochlorothiazide 12.5 mg daily used in the HOPE-3 trial has not been shown to reduce cardiovascular events [22].

A systematic review and meta-analysis was performed in 123 studies of randomized studies of use of antihypertensive drugs which included 613, 815 participants [23••]. This study demonstrated that every 10 mmHg reduction in systolic blood pressure significantly reduced major cardiovascular events by 20%, coronary heart disease by 17%, stroke by 27%, and heart failure by 28%, which in the populations studied reduced all-cause mortality by 13% [23••].

Blood Pressure Treatment Goals Recommended by 2011 to 2017 Hypertension Guidelines

Table 2 shows the blood pressure treatment goals for elderly persons recommended by 2011 to 2017 hypertension guidelines. The American College of Cardiology Foundation/American Heart Association 2011 expert consensus document on hypertension in the elderly developed in collaboration with the American Academy of Neurology, the American Geriatrics Society, the American Society for Preventive Cardiology, the American Society of Hypertension, the American Society of Nephrology, the Association of Black Cardiologists, and the European Society of Hypertension recommended that the blood pressure be lowered to less than 140/90 mmHg in older persons younger than 80 years and to 140 to 145/<90 mmHg if tolerated in adults aged 80 years and older [2].

Table 2 Blood pressure treatment goals recommended by the 2011–2017 Hypertension Guidelines

1. The blood pressure should be lowered to less than 140/90 mmHg in older persons younger than 80 years and to 140 to 145/<90 mmHg if tolerated in adults aged 80 years and older [2].
2. The blood pressure should be lowered in older adults younger than 80 years to less than 140/90 mmHg [24]. In adults older than 80 years, the systolic blood pressure should be lowered to between 140 and 150 mmHg provided they are in good physical and mental conditions [24].
3. The blood pressure should be lowered in adults aged 60 years or older to less than 150/90 mmHg if they do not have diabetes mellitus or chronic kidney disease and to less than 140/90 mmHg if they have diabetes mellitus or chronic kidney disease [25].
4. The blood pressure should be lowered in adults aged 60 years and older to less than 140/90 mmHg [26].
5. The blood pressure should be lowered to less than 140/90 mmHg in adults aged 60 to 79 years and to less than 150/90 mmHg in adults aged 80 years and older [27].
6. The blood pressure should be lowered to less than 140/90 mmHg in adults aged 60 to 79 years and to less than 150/90 mmHg in adults aged 80 years and older [28].
7. The blood pressure should be lowered to less than 140/90 mmHg in adults aged 60 to 79 years and to less than 150/90 mmHg in adults aged 80 years and older [29••].
8. The blood pressure should be lowered to less than 140/90 mmHg in patients with coronary artery disease and with an acute coronary syndrome if they are aged 80 years and younger but to less than 150 mmHg if they are older than 80 years of age [30••]. Consideration can be given to reduce the blood pressure to less than 130/80 mmHg [30••]. Caution is advised in reducing a diastolic blood pressure to less than 60 mmHg in persons with diabetes mellitus or in persons older than 60 years of age [30••].
9. High-risk adults aged 50 years and older with a systolic blood pressure of 130 mmHg or higher obtained by an automated office blood pressure measurement should have a target systolic blood pressure goal of 120 mmHg or lower [31••]. High-risk patients for treatment with intensive blood pressure management include those with clinical or subclinical cardiovascular disease or chronic kidney disease or an estimated 10-year global cardiovascular risk of 15% and higher or an age of 75 years and higher [31••].
10. Selected high cardiovascular risk persons should have a systolic blood pressure goal of less than 120 mmHg to improve cardiovascular outcomes [32••]. Close monitoring should be performed in these persons to identify treatment-related adverse effects including hypotension, syncope, electrolyte abnormalities, and acute kidney injury [32••].
11. Adults aged 60 years and older with a systolic blood pressure of 150 mmHg and higher should have their systolic blood pressure reduced to less than 150 mmHg [33••]. Adults aged 60 years and older with a history of stroke or transient ischemic attack should have their systolic blood pressure reduced to less than 140 mmHg [33••]. Adults aged 60 years and older at high cardiovascular risk should have their systolic blood pressure reduced to less than 140 mmHg [33••].

The European Society of Hypertension/European Society of Cardiology 2013 guidelines for management of hypertension recommend lowering the blood pressure in older adults younger than 80 years to less than 140/90 mmHg [24]. In adults older than 80 years, the systolic blood pressure should be lowered to between 140 and 150 mmHg provided they are in good physical and mental conditions [24].

The 2013 Eighth Joint National Committee (JNC 8) guidelines for management of hypertension recommended lowering the blood pressure in adults aged 60 years or older to less than 150/90 mmHg if they do not have diabetes mellitus or chronic kidney disease and to less than 140/90 mmHg if they have diabetes mellitus or chronic kidney disease [25]. These guidelines were not endorsed by any professional societies. The minority view from JNC 8 recommended lowering the blood pressure in adults aged 60 years and older with hypertension to less than 140/90 mmHg [26].

The Association of Black Cardiologists and the Working Group on Women's Cardiovascular Health support a blood pressure goal of less than 140/90 mmHg in adults aged 60 to 79 years and of less than 150/90 mmHg in adults aged 80 years and older [27]. I concur with their statement that following the 2013 JNC guidelines would cause an increase in cardiovascular events and mortality, especially in older women and blacks [27].

The 2013 Canadian Hypertension Education Program guidelines recommend lowering the blood pressure to less than 140/90 mmHg in elderly persons younger than 80 years of age and to less than 150/90 mmHg in persons aged 80 years and older [28]. The American Society of Hypertension/International Society of Hypertension 2014 hypertension guidelines also recommend lowering the blood pressure to less than 140/90 mmHg in elderly persons younger than 80 years and to less than 150/90 mmHg in persons aged 80 years and older [29••].

The American Heart Association/American College of Cardiology/American Society of Hypertension 2015 guidelines on treatment of hypertension in patients with coronary artery disease recommend that the target blood pressure should be below 140/90 mmHg in patients with coronary artery disease and with an acute coronary syndrome if they are aged 80 years and younger but below 150/90 mmHg if they are older than 80 years of age [30••]. Consideration can be given to reduce the blood pressure to less than 130/80 mmHg [30••]. Caution is advised in reducing a diastolic blood pressure to less than 60 mmHg in persons with diabetes mellitus or in persons older than 60 years of age [30••].

The Canadian 2016 hypertension guidelines recommend that high-risk adults aged 50 years and older with a systolic blood pressure of 130 mmHg or higher obtained by an automated office blood pressure measurement should have a target systolic blood pressure goal of 120 mmHg or lower [31••]. High-risk patients for treatment with intensive blood pressure management include those with clinical or subclinical cardiovascular disease or chronic kidney disease or an estimated 10-year global cardiovascular risk of 15% and higher or an age of 75 years and higher [31••].

The National Heart Foundation of Australia 2016 hypertension guidelines state that in selected high cardiovascular risk persons, a systolic blood pressure goal of less than 120 mmHg can improve cardiovascular outcomes [32••]. Close monitoring should be performed in these persons to identify treatment-related adverse effects including hypotension, syncope, electrolyte abnormalities, and acute kidney injury [32••].

The 2017 American College of Physicians/American Academy of Family Physicians 2017 hypertension guidelines made three recommendations [33••]. (1) Adults aged 60 years and older with a systolic blood pressure of 150 mmHg and higher should have their systolic blood pressure reduced to less than 150 mmHg. (2) Adults aged 60 years and older with a history of stroke or transient ischemic attack should have their systolic blood pressure reduced to less than 140 mmHg. (3) Adults aged 60 years and older at high cardiovascular risk should have their systolic blood pressure reduced to less than 140 mmHg [33••]. The 2017 hypertension guidelines from the American College of Cardiology, American Heart Association, and nine other professional societies should be published in 2017.

Drug Treatment of Elderly Persons with Hypertension

A meta-analysis of 147 randomized trials of 464, 000 persons with hypertension found that except for the major effect of beta blockers given after myocardial infarction in reducing coronary events and a minor additional effect of calcium channel blockers in reducing stroke, all major antihypertensive drug classes diuretics, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, beta blockers, and calcium channel blockers caused a similar reduction in coronary events and stroke for a given reduction in blood pressure [34]. The choice of specific antihypertensive drugs such as diuretics, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, beta blockers, or calcium channel blockers in the treatment of elderly persons with hypertension depends on efficacy, tolerability, presence of specific comorbidities and cost [2].

The drug regimen for diabetics should include an angiotensin-converting enzyme inhibitor or angiotensin receptor blocker [35]. An angiotensin-converting enzyme inhibitor or angiotensin receptor blocker should be used in patients with chronic kidney disease with or without diabetes mellitus [36, 37]. Beta blockers should be used to treat elderly patients with complex ventricular arrhythmias, heart failure, angina pectoris, prior myocardial infarction, supraventricular tachyarrhythmias such as atrial fibrillation with a rapid ventricular rate, hyperthyroidism, preoperative hypertension, migraine, or essential tremor [2 , 30•• , 38, 39].

In addition to beta blockers, elderly patients with heart failure should be treated with diuretics and angiotensin-converting enzyme inhibitors and with aldosterone antagonists if needed [2, 30••, 40]. Diuretics and angiotensin-converting enzyme inhibitors are recommended to prevent recurrent stroke in elderly patients with hypertension [38]. Thiazide diuretics should be used to treat elderly patients with osteoporosis [38]. Diuretics and calcium channel blockers are preferred in elderly patients with isolated systolic hypertension [24].

Figure 1 shows the treatment of elderly patients with hypertension and stable coronary artery disease. The beta blockers used should include carvedilol, metoprolol succinate, metoprolol tartrate, propanolol, timolol, nadolol, and bisoprolol. Atenolol should be avoided [39, 41–46]. Four studies compared atenolol with placebo (three studies) or atenolol with untreated controls (one study) [4, 42–46]. At 4.6-year follow-up of 6825 patients in these four studies, atenolol did not decrease all-cause mortality, cardiovascular mortality, or myocardial infarction but caused an insignificant 15% reduction in stroke [42–46]. The meta-analysis also demonstrated in 5 studies of 17,671 patients followed for a mean of 4.6 years comparing atenolol with other antihypertensive drugs that atenolol significantly increased mortality by 13%, cardiovascular mortality by 16%, and stroke by 30% [42–46]. Inadequate dosing of once daily dosing of a drug that does not last 24 h may contribute to these results.

Unanswered Questions

The SPRINT trial provides very important information on the efficacy and safety of lowering the systolic blood pressure to less than 120 mmHg measured by a validated automated device for office blood pressure measurements using a standard protocol in elderly adults with hypertension [17••, 18••, 47, 48]. The new hypertension guidelines will have to answer on the basis of expert medical opinion many questions not answered by SPRINT [17••, 18••]. One of these questions is what should be the target diastolic blood pressure in elderly persons. Long-term follow-up of adverse renal outcomes from a systolic blood pressure below 120 mmHg in SPRINT also needs to be performed.

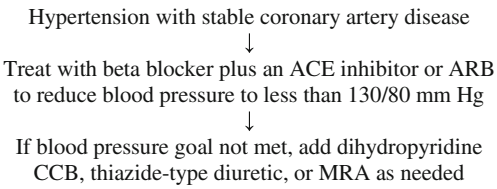

Fig. 1 Treatment of hypertension in elderly patients with stable coronary artery disease. *ACE* angiotensin-converting enzyme, *ARB* angiotensin receptor blocker, *CCB* calcium channel blocker, *MRA* mineralocorticoid receptr antagonist

The SPRINT investigators are investigating the effects of a systolic blood pressure below 120 mmHg versus below 140 mmHg in the elderly on the incidence of dementia, changes in cognitive function, and cerebral small-vessel ischemic disease. We are awaiting publication of these very important data.

Randomized clinical trial data are needed to investigate the effects of a systolic blood pressure less than 120 versus less than 140 mmHg on clinical outcomes in elderly patients with heart failure and a reduced left ventricular ejection fraction, in elderly patients with heart failure and a preserved left ventricular ejection fraction, and in elderly patients with a left ventricular ejection fraction below 35% since these patients were excluded from SPRINT. I favor treating these elderly patients to a blood pressure goal of less than 130/80 mmHg.

Patients with a prior stroke and patients with an estimated glomerular filtration rate less than 20 ml/min/1.73 m^2 were also excluded from SPRINT. Until randomized clinical trial data are available for the optimal blood pressure in these patients, I recommend that the target blood pressure in these elderly patients should be less than 130/80 mmHg.

Patients with diabetes mellitus were also excluded from SPRINT. In The ACTION to Control Cardiovascular Risk in Diabetes Blood Pressure (ACCORD BP) trial, lowering the systolic blood pressure to less than 120 mmHg in 4733 persons insignificantly lowered the composite primary outcome of myocardial infarction, stroke, or cardiovascular death by 12% but significantly lowered the incidence of stroke (a prespecified secondary outcome) by 41% (p = 0.01) [49]. The patients in SPRINT were older (mean age 67.9 years) than those in ACCORD BP (mean age 62.2 years). The patients in ACCORD BP were at lower risk than the patients in SPRINT. Patients with dyslipidemia were assigned to the lipid arm and excluded from the blood pressure arm in ACCORD BP. Patients with a serum creatinine above 1.5 mg/dL were also excluded from ACCORD BP. In addition, the use of diuretics was different in these trials. ACCORD BP often used hydrochlorothiazide, whereas SPRINT primarily used chlorthalidone (my preference) [50].

A post hoc analysis of the results from ACCORD BP also demonstrated that the primary cardiovascular disease outcome was reduced 26% in patients randomized to intensive blood pressure treatment and standard glycemia goals than in patients randomized to standard blood pressure treatment and standard glycemia goals [51]. In addition, targeting a systolic blood pressure of less than 120 mmHg in ACCORD BP was associated with a 39% lower risk of electrocardiographic left ventricular hypertrophy (p = 0.008) [52]. The ACCORD BP trial also demonstrated that hypertensive diabetics treated to a systolic blood pressure goal of less than 120 mmHg had a tendency to a reduced incidence of orthostatic hypotension than those randomized to a systolic blood pressure goal of less than 140 mmHg [53, 54].

A new definition of hypertension is needed after the results of SPRINT [55]. I favor diagnosing hypertension if the systolic blood pressure is 130 mmHg or higher or if the diastolic blood pressure is 80 mmHg or higher and would treat these persons with drug therapy plus lifestyle measures. I favor diagnosing increased blood pressure if the systolic blood pressure is 120 to 129 mmHg and the diastolic blood pressure is less than 80 mmHg and would treat these persons with lifestyle measures. I favor diagnosing normal blood pressure if the blood pressure is less than 120/80 mmHg, regardless of age.

Finally, I favor using predicted cardiovascular disease risk in conjunction with blood pressure to guide antihypertensive medication treatment as recommended [56]. This needs investigation.

Conclusion

A new definition of hypertension is needed after the results of SPRINT. I favor diagnosing hypertension in the elderly if the systolic blood pressure is 130 mmHg or higher or if the diastolic blood pressure is 80 mmHg or higher and would treat these elderly persons with drug therapy plus lifestyle measures. I favor diagnosing increased blood pressure in the elderly if the systolic blood pressure is 120 to 129 mmHg and the diastolic blood pressure is less than 80 mmHg and would treat these elderly persons with lifestyle measures.

The SPRINT trial provides very important information on the efficacy and safety of lowering the systolic blood pressure to less than 120 mmHg measured by a validated automated device for office blood pressure measurements using a standard protocol in elderly adults with hypertension. The new hypertension guidelines will have to answer on the basis of expert medical opinion many questions not answered by SPRINT. Finally, I favor using predicted cardiovascular disease risk in conjunction with blood pressure to guide antihypertensive medication treatment in elderly persons.

Compliance with Ethical Standards

Conflict of Interest The author declare that he has no conflicts of interests to declare.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by the author.

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