Assessment of blood pressure in patients with hypertension aged 60–79 years before and after the publication of the 2014 Eighth Joint National Committee report

Cy W. Fixen, Joseph J. Saseen, Joseph P. Vande Griend and Sunny A. Linnebur

Abstract

Objectives: In late 2013, the Joint National Committee (JNC 8) published hypertension treatment recommendations endorsing a goal blood pressure (BP) of < 150/90 mmHg starting at age 60 years. This was in contrast to other cardiovascular groups recommending age 80 years for this BP goal. This study examined mean BP in patients from age 60 years to 79 years with hypertension before and after publication of the JNC 8 recommendations.

Methods: This retrospective cohort study examined mean BP and number of antihypertensives for a period of 1 year before and after the release of the JNC 8 report. Patients aged 60–79 years with hypertension receiving care at a University of Colorado Hospital primary care clinic were included. Patients with diabetes, chronic kidney disease, or kidney transplant were excluded. A total of 150 BP measurements were included in each of the before and after time frames. The primary outcomes were change in mean BP and number of antihypertensives.

Results: A total of 171 patients met the criteria and were included in the study. Most had BPs in both the before and after time frames. Mean BP values were similar in the before and after groups (130.2/75.9 mmHg *versus* 131.5/76.6, respectively; $p = 0.27/p = 0.46$). Mean number of antihypertensives were similar in the before and after groups (1.95 *versus* 1.93, respectively; $p = 0.79$).

Conclusions: Over 1 year at an academic health system, new recommendations from the JNC 8 did not affect mean BP or number of antihypertensives in older patients with hypertension. A similar investigation after more time or in patients with newly diagnosed hypertension may help determine the full impact.

Keywords: aged, evidence-based medicine, guideline adherence, hypertension

Introduction

Prevalence of cardiovascular (CV) disease in the USA has decreased over the past several decades. Between 1979 and 2007, age-adjusted death due to stroke and ischemic heart disease decreased by 57% and 63%, respectively. Over a similar time period from 1976 to 2008, awareness of the presence of hypertension increased from 51% to 81%, treatment from 31% to 73%, and control from 10% to 50% [Kotchen, 2011]. These improvements in hypertension awareness and treatment have been speculated as contributing to this reduction in CV events [Lackland *et al.* 2014; Wright *et al.* 2014].

A total of 72 million people in the USA have high blood pressure (BP), and approximately half are older than 60 years of age [Nwankwo *et al.* 2013; Centers for Disease Control and Prevention, 2015]. Treatment of hypertension, including BP targets, has changed through the years to reflect findings from the constant influx of evidence from clinical trials and meta-analyses. Despite the large percentage of older adults with hypertension, relatively few studies have specifically evaluated specific BP targets in this population. The evidence that does exist in older adults supports a BP target of < 150 mmHg based on the reduced incidence of CV events from high-quality, randomized

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controlled trials [SHEP Cooperative Research Group, 1991; Beckett *et al.* 2008; Staessen *et al.* 1997]. Other trials have also shown CV benefit when treating BP to < 140 mmHg, but these studies either enrolled a broader age range of patients or were conducted in homogeneous Asian populations [ALLHAT Officers and Coordinators for the ALLHAT Collaborative Research Group, 2002; Julius *et al.* 2004; JATOS Study Group, 2008].

Most evidence-based guidelines (EBGs) for management of hypertension recommend a more lenient BP goal of < 150/90 mmHg for those age 80 years and older compared with younger patients. This more lenient BP goal is primarily based on findings from the Hypertension in the Very Elderly Trial (HYVET), which demonstrated CV benefit when targeting a systolic BP goal of < 150 mmHg in this age group [Beckett *et al.* 2008; Weber *et al.* 2014; ESH/ESC Task Force for the Management of Arterial Hypertension, 2013; Hackam *et al.* 2013; National Clinical Guideline Centre (UK), 2011]. Given the relative lack of high-quality evidence directly comparing CV outcomes when targeting systolic BPs of < 140 mmHg and < 150 mmHg in older adults younger than 80 years old, prominent CV-related professional organizations, such as the American Heart Association, American Society of Hypertension, International Society of Hypertension, European Society of Hypertension, and the European Society of Cardiology, have not recommended the more lenient BP goal in this population.

In late 2013, the Eighth Joint National Committee (JNC 8) published an updated EBG that recommended a BP goal of < 150/90 mmHg starting at age 60 years instead of 80 years for patients without diabetes or chronic kidney disease (CKD). Authors cite the improved CV endpoints demonstrated in the HYVET, Systolic Hypertension in the Elderly Program (SHEP), and Systolic Hypertension in Europe (SystEUR) trial as the rationale for their recommendation of treating hypertension to a systolic BP target of < 150 mmHg [James *et al.* 2014]. This more lenient goal may theoretically reduce the likelihood of adverse effect from medications, such as hypotension, and potentially decrease the number or dose of antihypertensive medications needed to achieve BP control. Many experts have a concern that a more lenient BP goal starting at age 60 years will reverse the trend seen in decreased CV events over the past 40 years. This current study

examined whether the recommendations made in the JNC 8 report have had an impact on BP control in patients aged 60–79 years without diabetes or CKD within 1 year of publication of the document.

Methods

The objective of this retrospective cohort study was to examine mean BP values and mean number of antihypertensive medications in patients with hypertension aged 60–79 years. Inclusion criteria were receiving care at a University of Colorado Hospital primary care clinic, diagnosis of hypertension (ICD-9 code 401.x), and aged 60–79 years old during the study period. Exclusion criteria were a diagnosis of diabetes (ICD-9 code 250.x), CKD (ICD-9 code 585.x), or kidney transplant (ICD-9 code V42.0). Two cohorts were created: the before cohort was defined as patients with a stable BP measured during the year before the JNC 8 report was published (17 December 2012 to 17 December 2013), and the after cohort was defined as those with BP measured during the year after the report was published (18 December 2013 to 18 December 2014). Patients were not required to have a BP recorded in both the before and after time frame, but both were collected when available.

The primary outcomes examined were change in mean BP and mean number of antihypertensive medications within the cohort time frames. A report was run using the institution's electronic medical record (EMR) to identify eligible patients. The list of eligible patients was randomized using Microsoft® Excel® (v14.5.0), and patients were then selected in order and manual chart review was performed until at least 150 patients were identified for each of the two cohorts. During the manual chart review, further exclusions were applied: patients with two or more episodes of proteinuria (albumin $\geq$ 30 mg/day), stable serum creatinine > 1.5 μ mol/l, hemoglobin A1c $\geq$ 6.5%, or patients who were prisoners. A sample size of 150 patients in each group was *a priori* determined to meet a power of 80%, and to show a difference between groups in systolic and diastolic BP of 5 mmHg.

The following data were collected for each patient: most recent stable BP within 1 year before and/or after the JNC 8 report was published on 18 December 2013 (i.e. closest to 18 December 2013 and 18 December 2014, respectively), number of antihypertensive medications,

Table 1. Baseline characteristics of the study population.

	Before (<i>n</i> = 151)	After (<i>n</i> = 151)	<i>p</i> -value
Mean age – years $\pm$ SD	68.0 $\pm$ 5.0	67.7 $\pm$ 4.8	0.60
Women – <i>n</i> (%)	96 (63.6)	94 (62.3)	0.81
Mean hemoglobin A1c – % $\pm$ SD	5.64 $\pm$ 0.34	5.64 $\pm$ 0.35	0.99
Mean body mass index – kg/m ² $\pm$ SD	29.6 $\pm$ 5.9	29.5 $\pm$ 5.8	0.84
Mean serum creatinine – μ mol/l $\pm$ SD	79.5 $\pm$ 17.6	79.5 $\pm$ 17.6	0.57
Mean number of active medications $\pm$ SD	10.4 $\pm$ 5.0	10.1 $\pm$ 4.9	0.61
On statin therapy – <i>n</i> (%)	87 (57.6)	90 (59.6)	0.73
Mean history of falls – <i>n</i> (%)	2 (1.3)	2 (1.3)	1.00
Mean Charlson comorbidity index $\pm$ SD – (range)	4.29 (2,12)	4.12 (2,12)	0.35
Myocardial infarction – <i>n</i> (%)	3 (2)	2 (1.3)	1.00
Congestive heart failure – <i>n</i> (%)	5 (3.3)	4 (2.6)	1.00
Peripheral disease – <i>n</i> (%)	7 (4.6)	6 (4.0)	0.78
Cerebrovascular disease – <i>n</i> (%)	8 (5.3)	10 (6.6)	0.63
Dementia – <i>n</i> (%)	1 (0.7)	0	1.00
Chronic pulmonary disease – <i>n</i> (%)	26 (17.2)	23 (15.2)	0.64
Connective tissues disease – <i>n</i> (%)	6 (4.0)	3 (2)	0.50
Peptic ulcer disease – <i>n</i> (%)	1 (0.7)	0	1.00
Mild liver disease – <i>n</i> (%)	8 (5.3)	7 (4.6)	0.79
Hemiplegia – <i>n</i> (%)	0	0	1.00
Tumor without metastasis – <i>n</i> (%)	31 (20.5)	29 (19.2)	0.77
Leukemia – <i>n</i> (%)	1 (0.7)	1 (0.7)	1.00
Lymphoma – <i>n</i> (%)	0	0	1.00
Moderate or severe liver disease – <i>n</i> (%)	0	0	1.00
Metastatic solid tumor – <i>n</i> (%)	4 (2.6)	2 (1.3)	0.68
AIDS – <i>n</i> (%)	1 (0.7)	1 (0.7)	1.00

Note: Several Charlson comorbidity index items are not reported above since they were patient populations excluded from the study.

total number of active medications, and other patient-specific factors reported in Table 1. A stable BP was defined as a BP measured while a patient was on a stable antihypertensive regimen for at least 2 weeks and the absence of acute illness or pain. If a BP was repeated during an office visit, the lowest BP was recorded. A prespecified subgroup analysis based upon age 60–69 years and 70–79 years was also conducted.

Unpaired Student's *t*-tests were used to compare the primary outcomes and all other continuous variables utilizing Microsoft® Excel® (v14.5.0). For the analysis of patients who were included in both cohorts, a paired Student's *t*-test was used to evaluate change in mean BP and number of anti-hypertensives. Chi-square and Fisher's exact tests were utilized to compare categorical data between groups, such as the presence of patient-specific factors, using contingency tables in 2015 GraphPad Software®. The Chi-square test was used when the

characteristic of interest occurred in at least five people and Fisher's exact test for less frequent events. For all analyses, an α of 0.05 was considered statistically significant. This study was approved by the Colorado Multiple Investigational Review Board.

Results

A total of 171 patients met study criteria, and each of the two cohorts included 151 patients. Of note, 131 patients were eligible for, and included in both cohorts. The two cohorts were similar with regard to baseline characteristics, and there were no statistically significant differences between groups. The average age was 68 years, the average number of prescribed medications was 10 or more, and roughly 67% were women. The average Charlson comorbidity index scores were 4.12 and 4.29 in the before and after groups, respectively.

Table 2. Results of primary outcomes and subgroup analysis by age group.

	Before	After	p-value
Systolic BP – mean $\pm$ SD, mmHg (n)			
All patients	130.2 $\pm$ 12.6 (151)	131.5 $\pm$ 13.2 (151)	0.27
Patients age 60–69 years	128.5 $\pm$ 11.4 (94)	131.6 $\pm$ 13.1 (98)	0.08
Patients age 70–79 years	132.9 $\pm$ 14.1 (57)	131.2 $\pm$ 13.4 (53)	0.50
Diastolic BP – mean $\pm$ SD, mmHg (n)			
All patients	75.9 $\pm$ 9.5 (151)	76.6 $\pm$ 9.5 (151)	0.46
Patients age 60–69 years	77.1 $\pm$ 9.3 (94)	77.9 $\pm$ 9.2 (98)	0.54
Patients age 70–79 years	74 $\pm$ 9.5 (57)	74.3 $\pm$ 9.6 (53)	0.86
Number of antihypertensives – mean $\pm$ SD (n)			
All patients	1.95 $\pm$ 0.9 (151)	1.93 $\pm$ 0.9 (151)	0.79
Patients age 60–69 years	1.95 $\pm$ 0.85 (94)	1.87 $\pm$ 0.85 (98)	0.96
Patients age 70–79 years	1.95 $\pm$ 1.01 (57)	2.04 $\pm$ 0.96 (53)	0.79

BP, blood pressure; SD, standard deviation.

Among patients aged 60–79 years old, there were no differences in primary outcomes of mean systolic BP (130.2 mmHg *versus* 131.5 mmHg; $p = 0.27$), diastolic BP (75.9 mmHg *versus* 76.6 mmHg; $p = 0.46$), or number of antihypertensives (1.95 *versus* 1.93; $p = 0.79$) between the before and after groups, respectively (Table 2). In the prespecified subgroup analysis, results remained consistent in demonstrating no difference when subdivided to ages 60–69 years and 70–79 years (Table 2).

Several subsequent exploratory analyses were conducted. While there was no difference in the number of patients with systolic BP values > 150 mmHg between the two cohorts, there was a trend that more patients had systolic BP values > 140 mmHg in the after group (16.6% *versus* 23.2%; $p = 0.15$) (Figure 1). Among the 131 patients who were included in both cohorts, there were no differences in mean systolic BP (130.3 mmHg *versus* 130.8 mmHg; $p = 0.66$), diastolic BP (76.3 mmHg *versus* 75.8 mmHg; $p = 0.63$), or number of antihypertensives (1.95 *versus* 1.99; $p = 0.30$) before and after JNC 8 publication.

Discussion

In our academic primary care setting, mean BP values and mean number of antihypertensives did not appear to be affected by JNC 8 recommendations. The controversial nature of these recommendations and previously published data examining length of time needed to adopt EBGs may explain this finding. The JNC 8 panel was

Figure 1. Percentage of patients with systolic blood pressure higher than 140 mmHg and higher than 150 mmHg.

formed to update the previous National Heart, Lung and Blood Institute (NHLBI)-sponsored EBG in 2008. However, before consensus was reached, the NHLBI pulled away from its sponsorship of guidelines for management of chronic diseases. Subsequently, the committee originally appointed to the defunct JNC 8 panel published their recommendations [James *et al.* 2014]. The JNC 8 recommendations have since been met with resistance in the clinical community. Among the opposition is a minority group from within the panel itself and the American Heart Association. Both groups continue to endorse the previous general recommendation from JNC 7, targeting a systolic BP < 140 mmHg for patients age 60–79 years, until higher quality evidence is available [Wright *et al.* 2014; American Heart Association, 2015].

Due to the polarizing nature of the JNC 8 recommendations, a 1-year time period may not be long enough to see the full effect of JNC 8. Time studies have estimated that it can take as many as 4 years for EBG recommendations to be adopted in clinical practice, if adopted at all [Timmermans and Mauck, 2005]. For example, when a group of emergency room directors was polled about their knowledge of the first NHLBI-sponsored asthma guideline that had been published 4 years prior, less than half had heard of the guideline, about a quarter had read it, and those who read it did not consistently apply the evidence-based recommendations [Crain *et al.* 1995]. Other studies have suggested that even when providers have knowledge of recommendations from an EBG, the probability that he or she will follow those recommendations is between 50% and 67% [Timmermans and Mauck, 2005]. However, if the data are highly publicized or negative, a quicker uptake into clinical practice can occur [Bestul *et al.* 2004].

In contrast to the JNC 8 report, other major EBGs recommend a systolic BP target of < 140 mmHg for patients younger than 80 years [Weber *et al.* 2014; ESH/ESC Task Force for the Management of Arterial Hypertension, 2013; Hackam *et al.* 2013; National Clinical Guideline Centre (UK), 2011]. Since JNC 8 now recommends < 150 mmHg as a systolic target starting at age 60 years, examining hypertensive patients with systolic BPs > 140 and > 150 mmHg could be a more sensitive marker to determine the impact of the report. As expected, there was no difference between groups in number of patients with systolic BPs > 150 mmHg. However, the number of patients with systolic BPs > 140 mmHg increased noticeably from 16.6% before to 23.6% after the recommendations were published. Although this difference was not statistically significant, the study was not powered to examine this outcome. Further exploration of this finding may be warranted in patients newly diagnosed with hypertension, as this would be the group most likely to be affected by the JNC 8 recommendations.

In the subgroup of patients aged 60–69 years old, an increase was seen in average systolic BP from 128.5 mmHg in the before group to 131.6 mmHg in the after group ($p = 0.08$). While JNC 8 suggests a more lenient BP target starting at age 60 years, authors also advise no pharmacotherapy changes to allow BP to increase if the patient is stable on an antihypertensive regimen with systolic

BP < 140 mmHg and not experiencing adverse side effects [James *et al.* 2014]. When considering this recommendation, the above finding would be expected since patients are more likely to develop hypertension with age, so an older patient would be more likely to have already developed hypertension and be on a stable antihypertensive regimen. This further solidifies the need for future research to examine BP in patients recently diagnosed with hypertension.

Limitations of this study are largely due to its retrospective nature and that it was conducted at one site in the USA. Investigators had no way of knowing if clinical decisions regarding BP were in fact due to knowledge of the JNC 8 report recommendations or if providers consciously addressed BP during the visit. Problem lists in the EMR were used to gather information about patient-specific factors, such as history of falls and other comorbidities. As a result of this, the factors listed in Table 1 could be underreported, and clinicians could be selecting patient-specific BP goals using knowledge not documented in the EMR. Site-specific variability in clinical practice and documentation in the EMR could also be affecting the results of the study. In addition, this study is also limited by only collecting one BP for each patient in the before and after cohorts. Investigators attempted to control for this limitation by ensuring that each BP collected was while patients were on stable antihypertensive regimens and not acutely ill or in pain.

Further research examining patients at a different site in the USA for BP values, BP control, and number of antihypertensives beyond 1 year, as well as number of patients newly diagnosed with hypertension with systolic BP between 140 mmHg and 150 mmHg, would further determine the impact of the JNC 8 report. This retrospective study was an impact assessment which did not directly provide information to change clinical practice. It is unknown if a more lenient BP goal is being targeted in patients above age 60 years who are newly diagnosed with hypertension, or if it will have a negative effect on CV morbidity and mortality in the coming years. Current trials continue to examine BP goals which should be targeted. Results from the randomized, multicenter Systolic Blood Pressure Intervention Trial (SPRINT), comparing CV endpoints in patients aged 50 years and older when treating to either an intensive systolic BP goal of < 120 mmHg or the more standard goal of < 140 mmHg are expected

to impact the recommendation for lower BP goals in adults aged 50 years or older [Ambrosius *et al.* 2014]. Based on inclusion criteria, this study will likely include a large portion of older patients and has the potential to demonstrate further the impact of BP goals on CV morbidity and mortality in an older adult population. However, without these outcome studies, it may be that clinicians are, and should be, choosing blood-pressure goals based upon patient factors such as their physiologic age, frailty, and/or comorbidities rather than just the patient's numeric age.

Conclusion

In conclusion, the recommendations from the 2014 JNC 8 report did not appear to affect management of hypertension in patients aged 60–79 years over the course of 1 year in primary care clinics of our academic health system. A similar investigation after more time or examining a number of patients newly diagnosed with hypertension with systolic BP > 140 mmHg may help determine the full impact of the updated recommendations.

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Conflict of interest statement

The authors have no conflicts of interest to declare.

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