Incidence and Prognosis of Resistant Hypertension in Hypertensive Patients

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Background—Despite a recent American Heart Association (AHA) consensus statement emphasizing the importance of resistant hypertension, the incidence and prognosis of this condition are largely unknown.

Methods and Results—This retrospective cohort study in 2 integrated health plans included patients with incident hypertension in whom treatment was begun between 2002 and 2006. Patients were followed up for the development of resistant hypertension based on AHA criteria of uncontrolled blood pressure despite use of ≥3 antihypertensive medications, with data collected on prescription filling information and blood pressure measurement. We determined incident cardiovascular events (death or incident myocardial infarction, heart failure, stroke, or chronic kidney disease) in patients with and without resistant hypertension with adjustment for patient and clinical characteristics. Among 205 750 patients with incident hypertension, 1.9% developed resistant hypertension within a median of 1.5 years from initial treatment (0.7 cases per 100 person-years of follow-up). These patients were more often men, were older, and had higher rates of diabetes mellitus than nonresistant patients. Over 3.8 years of median follow-up, cardiovascular event rates were significantly higher in those with resistant hypertension (unadjusted 18.0% versus 13.5%, $P<0.001$). After adjustment for patient and clinical characteristics, resistant hypertension was associated with a higher risk of cardiovascular events (hazard ratio, 1.47; 95% confidence interval, 1.33–1.62).

Conclusions—Among patients with incident hypertension in whom treatment was begun, 1 in 50 patients developed resistant hypertension. Patients with resistant hypertension had an increased risk of cardiovascular events, which supports the need for greater efforts toward improving hypertension outcomes in this population. **(*Circulation*. 2012;125:1635-1642.)**

Key Words: hypertension ■ epidemiology ■ incidence ■ prognosis ■ outcomes

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Uncontrolled hypertension is one of the most important cardiovascular risk factors in the world today, and contributes to an elevated risk of stroke, myocardial infarction (MI), heart failure, and renal failure.[1,2] A recent scientific statement from the American Heart Association (AHA) defined resistant hypertension as blood pressure (BP) that remains above goal despite the concurrent use of 3 different antihypertensive medication classes, 1 ideally being a diuretic, with all agents prescribed at doses that provide optimal benefit.[3] Despite the recognition that these patients are a potentially higher-risk subset, patients with resistant hypertension have been poorly characterized in the literature.

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Prevalence estimates suggest anywhere from 3% to 30% of patients with hypertension require ≥3 medications to achieve BP control[4–9]; however, the incidence of resistant hypertension has not been well defined, and has been defined as a priority area by the AHA.[3] A greater understanding of the incidence and outcomes associated with resistant hypertension is important to improve the management of these patients. Prior studies on resistant hypertension are limited by failure to apply a uniform definition of resistant hypertension, lack of longitudinal BP data, and inability to identify pseudoresistant hypertension caused by poor medication adherence. Furthermore, the prognosis among patients with resistant hypertension compared with those without resistant hypertension is unknown.[3]

Accordingly, we assessed the incidence of resistant hypertension according to the AHA definition among ambulatory patients with newly treated hypertension from 2 large integrated health plans on the basis of hypertension medication prescriptions filled, BP measurements, and adherence data.[3]

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Next, among a subset of patients without prevalent cardiovascular disease, we compared the risk of subsequent death, MI, stroke, heart failure, and chronic kidney disease between patients classified as having resistant hypertension and those with nonresistant hypertension.

Methods

Study Population

The study sample was identified within 2 health plans within the Cardiovascular Research Network hypertension registry from 2002 to 2006. The development of the Cardiovascular Research Network hypertension registry has been described in detail elsewhere.[10,11] In brief, patients with hypertension at Kaiser Permanente Colorado and Kaiser Permanente Northern California were identified by a published algorithm that consisted of *International Classification of Diseases, 9th Revision* (*ICD-9*) diagnosis codes, BP measurements (from nonurgent visits), and pharmacy data.[12] The present analysis only includes patients with incident hypertension in whom antihypertensive medication treatment was begun. Incident hypertension was defined as being a member of the health plan for at least 1 year before meeting criteria for the registry, without any prior diagnosis of hypertension and without any prior pharmacy dispensing for antihypertensive medications (eg, diuretics, β-blockers, or angiotensin-converting enzyme inhibitors). Because the study inclusion and outcome criteria rely on diagnoses codes and pharmacy data, patients were required to have continuous health plan enrollment with pharmacy benefits for $\geq$1 year before and after cohort entry. Elevated BP was defined according to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure thresholds of systolic BP $\geq$140 mm Hg or diastolic BP $\geq$90 mm Hg, with lower cutoffs of systolic BP $\geq$130 mm Hg or diastolic BP $\geq$80 mm Hg for those with diabetes mellitus or chronic kidney disease.[13]

Definition of Incident Resistant Hypertension

To define those patients who developed resistant hypertension during follow-up, the 2008 AHA criteria were applied. First, patients were followed forward (from the time they began taking $\geq$1 antihypertensive medication) to assess whether they were ever taking $\geq$3 classes of antihypertensive medications for at least 1 month during the follow-up period. A 1-month interval was chosen to ensure persistent use of multiple antihypertensive medication classes. Patients taking combination antihypertensive pills were counted as taking separate classes for each drug (ie, thiazide diuretic and angiotensin-converting enzyme inhibitor). Patients were further divided into groups with controlled and uncontrolled hypertension on the basis of their BP measurement nearest to the date they began taking at least 3 antihypertensive medications. Hypertension control was based on current criteria of the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.[13]

Next, the study cohort patients taking $\geq$3 medications were followed up for 1 year to assess hypertension control based on the BP measurement closest to 1 year after they started taking 3 antihypertensive medications and to assess adherence to antihypertensive medications. Among those whose hypertension was controlled at 1 year, those taking $\geq$4 medications were considered resistant and those taking $\leq$3 medications were considered nonresistant, consistent with guideline recommendations.[3] Among those whose BP was not controlled at 1 year, those taking $<$3 medications were considered nonresistant and those taking $\geq$3 medications were considered resistant, consistent with the AHA statement.[3] Patients without medication refill information over the follow-up interval were labeled as "indeterminate" and excluded from further analysis.

To further delineate those with pseudoresistance (resistant hypertension caused by poor medication adherence), the group of patients with uncontrolled hypertension labeled as resistant was assessed for medication adherence during the year of follow-up. For each patient, a summary adherence measure was determined on the basis of adherence (proportion of days covered based on pharmacy refill information) to each antihypertensive medication over the 12-month interval and then averaged across classes of medications. Patients with a summary adherence measure of $<$80% were considered nonadherent.[14] Among patients whose BP was not controlled despite the use of $\geq$3 medications, those deemed nonadherent were reclassified as nonresistant for subsequent analysis.

Health Outcomes

The primary outcome was all-cause mortality and incident cardiovascular events, defined as nonfatal MI, congestive heart failure, stroke, or chronic kidney disease. For the primary analysis, the time to the combined outcomes of all-cause mortality or incident cardiovascular events was assessed, and patients with prior history of cardiovascular events before resistance status determination were excluded from these outcomes analyses. The presence of these conditions was determined on the basis of *ICD-9* diagnosis codes, problem list entries, and laboratory data according to prespecified algorithms. Death was ascertained from internal health system databases and state death records. Primary hospital discharge diagnoses were used to identify incident cases of MI (*ICD-9* code 410), congestive heart failure (*ICD-9* code 428), and stroke (*ICD-9* codes 430, 431, 432, 433, 434, and 436). Importantly, data on hospitalizations that occurred outside each health system were available through administrative claims data, which are considered highly accurate because they are used for reimbursement for out-of-system utilization. Both diagnosis data and laboratory measures of renal function were used to identify incident cases of chronic kidney disease. Patients with previously normal renal function were considered to have progressed to chronic kidney disease if, after entry into the cohort, they had a new diagnosis of kidney disease (*ICD-9* codes 585.1–585.9) or 2 consecutive estimated glomerular filtration rates $<60\ \text{mL} \cdot \text{min}^{-1} \cdot 1.73\ \text{m}^{-2}$ (based on the Modification of Diet in Renal Disease Study equation).[15]

Statistical Analysis

Among patients in whom antihypertension therapy was begun, rates of resistant hypertension were determined. Of the subset of patients who were given 3 medications for at least 1 month, baseline characteristics were compared between those eventually categorized as nonresistant (including those classified as pseudoresistant) and those with resistant hypertension by use of the χ^2 test for categorical variables and the Wilcoxon rank sum test for continuous variables.

For the primary outcomes analysis, among the cohort taking 3 BP medications for at least 1 month, freedom from the occurrence of the combined outcomes of death, nonfatal MI, congestive heart failure, stroke, and chronic kidney disease was estimated for resistant and nonresistant patients by the Kaplan-Meier method. Patients with prevalent MI, congestive heart failure, stroke, or chronic kidney disease were excluded from this analysis. Freedom from an event was measured from the time a patient began taking 3 medications until the patient experienced the first event of interest or the study ended. Patients were censored if they were lost to follow-up. Differences in event rates were evaluated with log-rank tests. Next, multivariable Cox proportional hazards regression models were constructed, with adjustment for year of cohort entry, study site, and patient characteristics (sex, race, age, body mass index, smoking status, alcohol abuse, angina, asthma, atrial fibrillation, other arrhythmias, bipolar disease, diabetes mellitus, depression, drug abuse, migraines, peripheral vascular disease, schizophrenia, and sleep apnea). In the secondary analysis, we compared the outcomes of patients with resistant hypertension and patients without resistant hypertension (regardless of number of medications) within Kaiser Colorado.

In sensitivity analyses of the cardiovascular outcomes models, patients whose BP was not controlled at 1 year despite taking $<$3 medications who were also nonadherent (n=1238) were excluded. These results were not significantly different and are not presented. Further analyses excluded those with pseudoresistant hypertension (n=269). Finally, because the chronic kidney disease outcome depended in part on the frequency of creatinine measurements,

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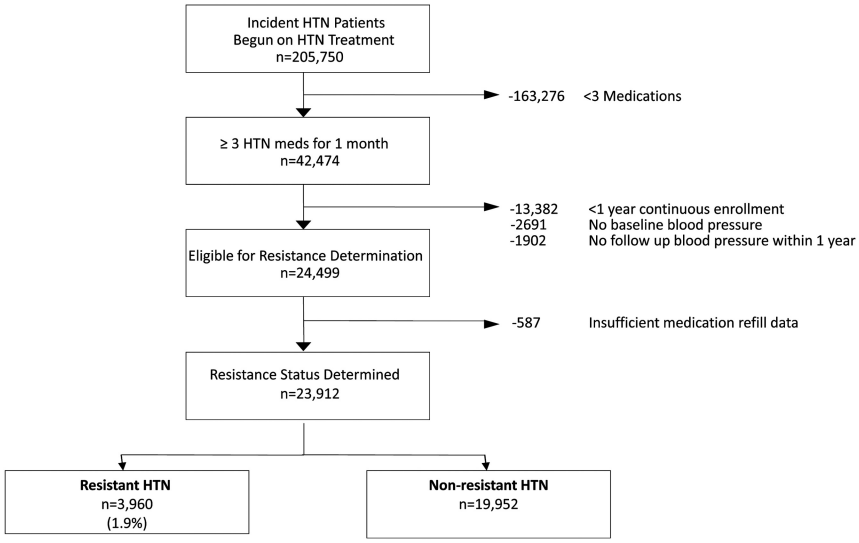

Figure 1. Flow chart of study population. HTN indicates hypertension.

additional analysis excluded this outcome from the primary models to decrease the chances of surveillance bias.

All analyses were performed with the SAS statistical package version 9.1 (SAS Institute, Cary, NC). The study was approved by the institutional review board of both health plans.

Results

Antihypertensive therapy was begun in a total of 205 750 patients with incident hypertension. Of these, 42 474 (20.6%) were taking ≥3 classes of antihypertensive medications concurrently for at least 1 month. An additional 13 382 patients (6.5%) were excluded because of the lack of continuous enrollment for at least 1 year after they began taking ≥3 antihypertensive medications. Patients without a baseline BP (n=2691) or a follow-up BP within 1 year (n=1902) were also excluded from further analyses. Our final study cohort included 24 499 patients who were eligible for resistance status determination (Figure 1).

Figures 2A and 2B examine the 24 499 patients in detail according to their baseline BP, follow-up BP at 1 year, and subsequent resistant status. For 587 patients, resistance status could not be determined because of the lack of medication refill data during the follow-up interval, which left a cohort of 23 912 patients for whom resistance status was determined. Of those with uncontrolled hypertension at 1 year, a total of 3472 patients were initially considered to have resistant hypertension on the basis of the number of medications; however, 430 patients (12.4%) had pseudoresistant hypertension caused by poor medication adherence. Furthermore, 918 patients were classified as having resistant hypertension because they had BP that was controlled with the use of ≥4 medications. Therefore, 1.9% of patients (n=3960) from the original incident hypertension cohort who were undergoing treatment (n=205 750) had resistant hypertension during a median 1.5 years (25th quartile 1.1 years; 75th quartile 2.5 years) from initial treatment, or 0.7 cases per 100 years of patient follow-up. Among those taking ≥3 medications for at least 1 month (n=24 499), the prevalence of resistant hypertension was 16.2% (Figures 2A and 2B).

Those with resistant hypertension were more likely to be male, of white race, and older and to have higher rates of baseline diabetes than those with nonresistant hypertension (Table 1). Patients with resistant hypertension were more likely to be taking β-blockers (78% versus 67%; $P<0.01$), calcium channel blockers (30% versus 23%; $P<0.01$), and α-adrenergic blockers (10% versus 7%; $P<0.01$) than those with nonresistant hypertension; otherwise, medication classes for hypertension treatment were similar between the 2 groups. The rates of diagnosed secondary hypertension causes (aortic coarctation, Cushing syndrome, pheochromocytoma, and primary aldosteronism) were extremely low (<1%) and did not vary according to resistance status (data not shown).

In the primary cardiovascular outcomes analysis, after removal of patients with cardiovascular events before the resistant status determination date (n=5876; 25%), a total of 18 036 patients remained (online-only Data Supplement Table I). Over the median 3.8 years of follow-up (25th quartile 2.6 years; 75th quartile 4.8 years), 344 deaths occurred, and the following numbers of incident cardiovascular events occurred: 90 nonfatal MIs, 91 strokes, and 53 congestive heart failure hospitalizations. A total of 1972 patients (11%) developed chronic kidney disease. In the unadjusted analysis, patients with resistant hypertension were significantly more likely to experience the combined outcomes of death, MI, congestive heart failure, stroke, or chronic kidney disease (18.0% versus 13.5%%, $P<0.001$; unadjusted hazard ratio, 1.54; 95% confidence interval, 1.40–1.69; Table 2). After multivariable adjustment that included baseline patient demographics, comorbidities, study site, and year of study entry, resistant hypertension was associated with an increased risk of adverse cardiovascular outcomes (hazard ratio, 1.47; 95% confidence interval, 1.33–1.62; $P<0.001$). The proportional hazards assumption for hypertension status (resistant versus nonresistant) was met for the multivariate Cox model.

In secondary analysis using a referent group of all patients with incident hypertension (regardless of medication class number) compared with patients with resistant hypertension at Kaiser Colorado alone (total n=16 963), patients who developed resistant hypertension (n=195) were significantly more likely to have adverse cardiovascular outcomes at any point during follow-up than those who did not develop

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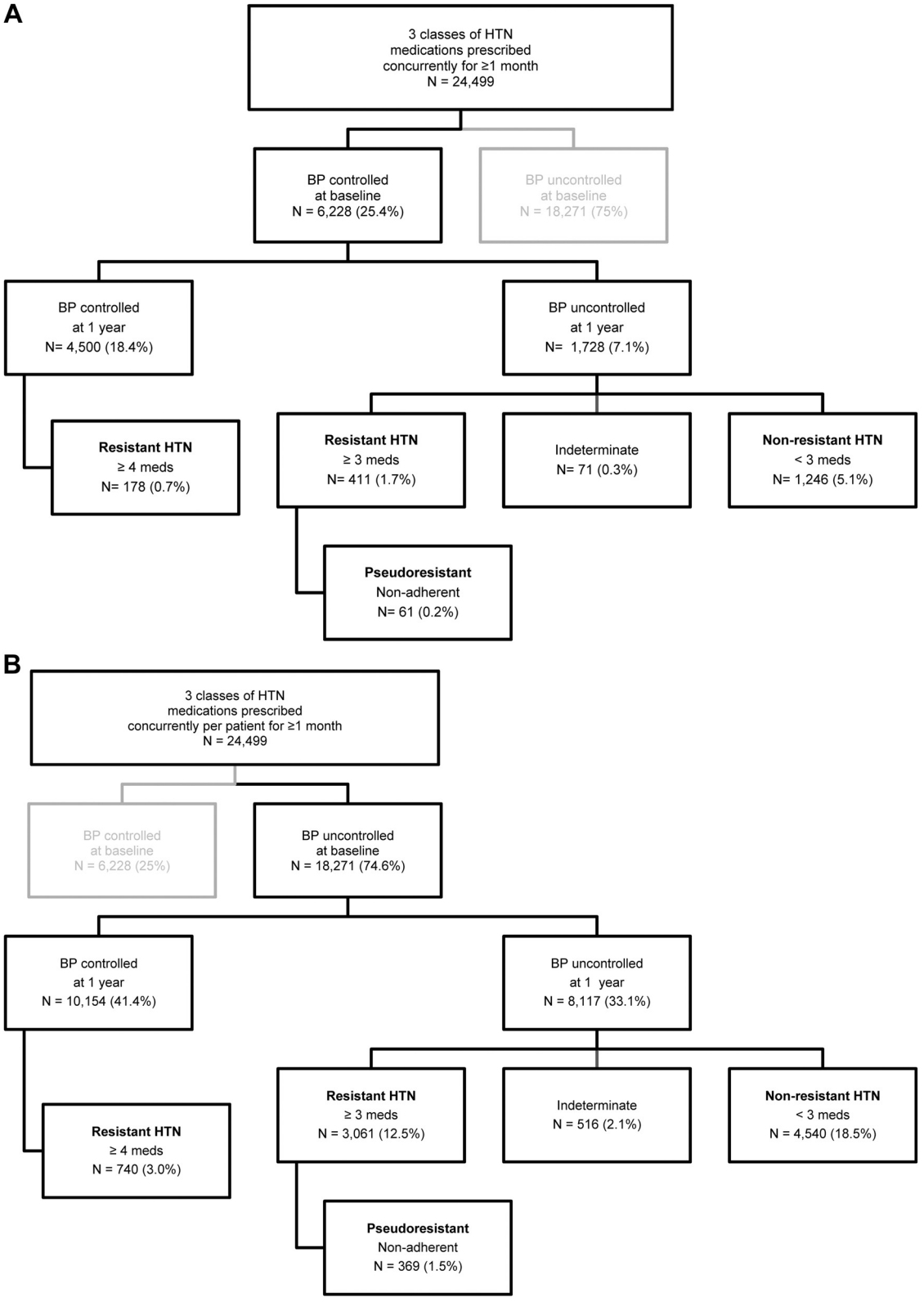

Figure 2. Determination of resistance status among those taking ≥3 medications for at least 1 month. **A**, Blood pressure (BP) controlled at baseline. **B**, BP uncontrolled at baseline. HTN indicates hypertension; meds, medications.

resistant hypertension (53.9% versus 14.5%; adjusted hazard ratio, 2.49; 95% confidence interval, 1.96–3.15).

In sensitivity analyses that excluded patients with pseudoresistant hypertension caused by poor medication adherence (n=269), patients with resistant hypertension remained at higher risk of adverse cardiovascular outcomes than patients with nonresistant hypertension (adjusted hazard ratio, 1.48; 95% confidence interval, 1.34–1.63; $P<0.001$). Finally,

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Table 1. Baseline Characteristics of Study Cohort Given 3 Medications for at Least 1 Month According to Their Eventual Hypertension Resistance Status

Characteristic	Resistant (n=3960)	Nonresistant (n=19 952)	*P*
Male sex, %	49.6	44.9	<0.01
Race, %			<0.01
Black	8.2	8.3	
Missing	11.8	11.9	
Other	19.6	22.9	
White	60.4	56.8	
Age, y*	60.6 (60.2–60.9)	58.7 (58.6–58.9)	<0.01
Baseline systolic BP, mm Hg*	153.4 (152.8–154.0)	144.6 (144.4–144.9)	<0.01
Baseline diastolic BP, mm Hg*	84.4 (84.0–84.9)	82.4 (82.2–82.6)	<0.01
Body mass index, kg/m^2*	30.8 (30.5–31.0)	29.9 (29.7–30.2)	<0.01
Current smoker, %	10.2	9.5	0.14
Site, %			<0.01
Kaiser Northern California	93.9	95.6	
Kaiser Colorado	6.1	4.4	
Year of hypertension registry entry, %			<0.01
2000	2.9	2.6	
2001	16.3	17.9	
2002	37.3	33.6	
2003	20.0	21.1	
2004	12.1	12.9	
2005	7.1	7.8	
2006	4.3	4.1	
Baseline comorbidities, %			
Albuminuria	0.7	0.4	0.02
Alcohol abuse	3.6	3.5	0.87
Angina	0.8	1.1	0.14
Asthma	9.2	12.4	<0.01
Atrial fibrillation	2.9	2.0	<0.01
Bipolar disorder	0.6	0.8	0.24
Coronary artery bypass	0.7	0.7	1.00
Congestive heart failure	1.9	1.3	<0.01
Chronic kidney disease	5.2	4.0	<0.01
Diabetes	17.7	9.6	<0.01
Depression	9.8	14.3	<0.01
Drug abuse	13.9	15.4	0.02
Myocardial infarction	1.5	1.1	0.06
Peripheral vascular disease	1.9	1.4	0.02
Sleep apnea	2.0	2.3	0.42
Stroke	2.6	1.9	<0.01
Baseline hypertension medications, %			
β-blocker	77.5	66.8	<0.01
ACE/ARB	69.1	69.8	0.43
All diuretics	92.2	92.0	0.57
Potassium-sparing diuretic	35.0	36.0	0.08
Calcium channel blocker	29.7	23.4	<0.01
α-Adrenergic blocker	9.6	7.4	<0.01
Peripheral vasodilator	1.1	0.6	<0.01

BP indicates blood pressure; ACE/ARB, angiotensin-converting enzyme/angiotensin receptor blocker.
*Continuous variables are presented as mean and 95% confidence interval.

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Table 2. Cardiovascular Outcomes Among Patients in the Primary Outcomes Analysis According to Resistance Status

Outcome	Resistant	Nonresistant	Total
Death	54 (2.1)	290 (1.9)	344 (1.9)
Myocardial infarction	9 (0.4)	81 (0.5)	90 (0.5)
Stroke	15 (0.6)	76 (0.5)	91 (0.5)
Congestive heart failure	10 (0.4)	43 (0.3)	53 (0.3)
Chronic kidney disease	365 (14.5)	1607 (10.4)	1972 (10.9)
Total events	453 (18.0)	2097 (13.5)	2550 (14.1)
Total patients	2521	15 515	18 036

Values are n (%).

there was a trend toward increased risk of adverse outcomes with resistant hypertension when the development of chronic kidney disease was not included as an outcome (adjusted hazard ratio, 1.18; 95% confidence interval, 0.98–1.43; $P=0.09$).

Discussion

Among a large community cohort of patients with incident hypertension in whom hypertension treatment was begun, 1.9% developed resistant hypertension within a median of 1.5 years from initial treatment, or 0.7 cases per 100 patient-years. Patients with resistant hypertension were almost 50% more likely to experience a cardiovascular event over a median 3.8 years of follow-up as patients without resistant hypertension.

One of the most important contributions of the present study is the estimate of the incidence of resistant hypertension. To the best of our knowledge, the present study is the first to show that among patients with incident hypertension in whom treatment is begun, 1 in 50 will go on to develop resistant hypertension. Current estimates have focused on the prevalence of resistant hypertension and are based on cross-sectional studies, international registries, claims databases, or large clinical trials.[3,6–9] The 2003 to 2008 National Health and Nutrition Examination Survey suggested that ≈12% of the antihypertensive drug–treated population met the criteria for resistant hypertension.[6,7] A Spanish registry cohort similarly found 12.2% of treated patients with hypertension met criteria for resistant hypertension.[8] Using claims data from >5 million patients with hypertension, Hanselin et al[9] found that 2.6% were taking ≥4 hypertension medications. Data from clinical trials suggest 20% to 35% of hypertensive patients have resistant hypertension, based on requiring ≥3 drugs to achieve BP control.[16–18] For example, in ALLHAT (Antihypertensive and Lipid-Lowering treatment to prevent Heart Attack Trial), at the study's completion, 27% of participants were taking ≥3 medications; only 49% had their BP controlled with use of 1 or 2 medications, which suggests that >50% would have needed ≥3 medications to achieve BP control. Among the present incident hypertension cohort in whom treatment was initiated (n=205 750), we found ≈21% (n=42 474) were taking ≥3 medications at some point during follow-up. After considering medication adherence and BP information, we demonstrated that only 16% (3960/24 499) of patients taking ≥3 medications continued to meet the AHA definition of resistant hypertension. Therefore, the present study suggests the prevalence of resistant hypertension among those taking multiple medications may be slightly higher than recent studies suggest.[6–8] In contrast to prior studies, the present study has the advantage of accounting for longitudinal BP control and medication adherence by use of detailed pharmacy information among a large community-based cohort of patients with hypertension.

Another important finding of the present study is the evaluation of prognosis of patients with resistant hypertension compared with those with nonresistant hypertension. Resistant hypertension was associated with a significantly increased risk of adverse cardiovascular events compared with nonresistant hypertension. Few studies have directly compared cardiovascular outcomes in those with resistant versus nonresistant hypertension.[19] A small study (n=86) using ambulatory BP monitoring demonstrated an almost 2-fold increased risk of cardiovascular events in patient with true resistant hypertension compared with those with hypertension responsive to treatment.[19] We were not able to distinguish those with false resistant hypertension or white coat hypertension (high office BP but normal ambulatory BP) in the present study; however, we also found an increased risk of adverse cardiovascular events among patients with resistant hypertension based on office BP measurements. Differences in cardiovascular events in the present study were largely caused by the development of chronic kidney disease, as defined by estimated glomerular filtration rates or diagnostic codes. Although this definition is less restrictive than one based on the need for hemodialysis, patients with all stages of chronic kidney disease are known to be at higher risk for poor outcomes than those with normal renal function.[20,21] Together, these studies suggest that resistant hypertension defined by either ambulatory or clinic-based BP measurements is associated with an increased risk of adverse outcomes and represents an important public health issue. Future studies should investigate the prognosis of patients with resistant hypertension in other community populations.

On the basis of the present study, ≈1 in 50 patients in whom antihypertensive treatment is begun will develop resistant hypertension within 1.5 years. In addition, we have shown that ≈1 in 6 patients taking ≥3 hypertension medications will continue to meet criteria for resistant hypertension over follow-up. Importantly, we have shown that adverse cardiovascular outcomes were significantly higher in those with resistant hypertension than in those without. These findings are significant, because the prevalence of resistant hypertension is expected to increase as a result of increased life expectancy and the increasing prevalence of factors commonly associated with resistant hypertension, such as obesity, diabetes, and chronic kidney disease.[22] In accordance with the AHA statement, our definition of resistant hypertension incorporates BP control as a criterion for resistance.[3] Therefore, we are unable to distinguish whether the tendency toward worse cardiovascular outcomes is inherent to resistant hypertension status itself or related to BP control. Whether the benefits of BP control demonstrated in numerous hypertension clinical trials can be translated to patients with

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resistant hypertension is unknown and warrants further study.[23–26]

Certain limitations should be considered in the interpretation of the study results. First, the present study relied on BP measurements from an electronic medical record; however, this method for determining hypertension has been validated previously.[11] In addition, as noted previously, the present study used office-based BP measurements alone; ambulatory BP measurements may provide more accurate estimates of resistant hypertension and have been shown to be more prognostic.[8,27] However, office-based BP measurements reflect current practice and are used routinely in the management of hypertension. It is also possible that some patients in the present study cohort were misclassified because we defined those whose BP was not controlled with <3 medications as nonresistant. Some of these patients could be resistant with further medication additions; yet our definition is based on the AHA scientific statement that defined resistant hypertension, and misclassification in this direction would bias our findings toward the null of no differences in cardiovascular outcomes between groups. Furthermore, the present study did not account for optimal dosing of each medication or the use of recommended drug combinations and did not require the use of a diuretic as defined in the AHA statement.[3,28] However, medication use and dosing in the present study represents real-world management choices, and >90% of patients were taking a diuretic at the time of resistant determination. Furthermore, we were unable to account for changes in body weight or patient salt consumption, which are associated with resistant hypertension. In addition, the incidence and prevalence estimates in the present study may not represent the true burden of disease because of the follow-up time frame available in the registry. With a longer follow-up interval, the incidence estimates would likely increase. Finally, the findings in these healthcare systems may not be generalizable to other healthcare settings; however, these 2 systems care for almost 4 million patients in geographically distinct areas, and the results for overall resistance rates were similar across sites (data not shown). Furthermore, the present study population was drawn from an ambulatory population of hypertension patients seen in both primary care and subspecialty clinics, whereas most prior studies have primarily studied resistant hypertension in subspecialty clinic populations.

Conclusions

In this cohort of patients from 2 health systems with incident hypertension, the rate of resistant hypertension was 1.9% within a median of 1.5 years from initial treatment. Furthermore, ≈1 in 6 patients taking ≥3 hypertension medications continued to meet criteria for resistant hypertension 1 year later. Importantly, patients with resistant hypertension were at higher risk for cardiovascular outcomes than those with nonresistant hypertension once patient demographic and clinical characteristics were taken into account. These findings support the need for greater efforts toward improving hypertension outcomes among patients with resistant hypertension. Future studies are needed to assess the prognosis of patients with resistant hypertension in additional community cohorts.

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Disclosures

None.

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CLINICAL PERSPECTIVE

The American Heart Association has defined resistant hypertension as blood pressure that remains above goal despite the concurrent use of 3 different antihypertensive medication classes. Despite the recognition that these patients are a potentially higher-risk subset, patients with resistant hypertension have been poorly characterized in the literature. Among a large community cohort of patients with incident hypertension in whom hypertension treatment was begun, we found that 1.9% developed resistant hypertension within a median of 1.5 years from initial treatment, or 0.7 cases per 100 patient-years. In addition, we found that ≈1 in 6 patients taking ≥3 hypertension medication classes for at least 1 month will continue to meet criteria for resistant hypertension over follow-up. Patients with resistant hypertension were almost 50% more likely to experience a cardiovascular event (death or incident myocardial infarction, heart failure, stroke, or chronic kidney disease) over a median 3.8 years of follow-up as patients without resistant hypertension. These findings support the need for greater efforts toward improving outcomes among patients with resistant hypertension.

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