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Post-stroke hypertension control and receipt of health care services among veterans

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Many ischemic stroke patients do not achieve goal blood pressure (BP < 140/90 mm Hg). To identify barriers to post-stroke hypertension management, we examined healthcare utilization and BP control in the year after index ischemic stroke admission. This retrospective cohort study included patients admitted for acute ischemic stroke to a VA hospital in fiscal year 2011 and who were discharged with a BP ≥ 140/90 mm Hg. One-year post-discharge, BP trajectories, utilization of primary care, specialty and ancillary services were studied. Among 265 patients, 246 (92.8%) were seen by primary care (PC) during the 1-year post-discharge; a median time to the first PC visit was 32 days (interquartile range: 53). Among N = 245 patients with post-discharge BP data, 103 (42.0%) achieved a mean BP < 140/90 mm Hg in the year post-discharge. Provider follow-ups were: neurology (51.7%), cardiology (14.0%), nephrology (7.2%), endocrinology (3.8%), and geriatrics (2.6%) and ancillary services (BP monitor [30.6%], pharmacy [20.0%], nutrition [8.3%], and telehealth [8%]). Non-adherence to medications was documented in 21.9% of patients and was observed more commonly among patients with uncontrolled compared with controlled BP (28.7% vs 15.5%; $P = .02$). The recurrent stroke rate did not differ among patients with uncontrolled (4.2%) compared with controlled BP (3.8%; $P = .89$). Few patients achieved goal BP in the year post-stroke. Visits to primary care were not timely. Underuse of specialty as well as ancillary services and provider perception of medication non-adherence were common. Future intervention studies seeking to improve post-stroke hypertension management should address these observed gaps in care.

1 | BACKGROUND

Hypertension is considered one of the most robust and modifiable risk factors for first ischemic stroke and recurrent stroke.[1-3] A meta-analysis of 16 randomized controlled trials demonstrated an 18% (95% confidence interval [CI], 9%-26%) relative risk reduction in recurrent strokes with effective BP-lowering treatment and they revealed that each 10-mm Hg reduction in systolic BP was associated

with a 33% (95% CI, 9%-51%) reduction in the risk of recurrent stroke.[4]

Despite the robust evidence and guideline recommendations to achieve goal BP (ie, < 140/90 mm Hg) post-ischemic stroke, hypertension remains uncontrolled for many patients throughout the year after an index cerebrovascular event.[1] Prior studies have reported a high prevalence (74%-82%) of elevated BP after discharge from an acute ischemic stroke hospitalization. These studies have also identified patients with elevated BP at the time of discharge as being particularly at risk for ongoing poorly controlled BP post-discharge.[5-8] Prior research has also demonstrated that post-stroke antihypertensive medication non-adherence as well as clinical inertia on the part of providers who do not intensify antihypertensive medication despite opportunities to do so also contribute to inadequate post-stroke hypertension control.[5]

Although these studies have addressed patient- and provider-level factors leading to uncontrolled risk factors for ischemic stroke,[6,9-11] less is known regarding the use of hypertension-related health care services for ischemic stroke patients. The goal of the current study was to describe the quality of hypertension care after hospitalization for an acute ischemic stroke and to better understand the factors that influence post-stroke BP control in the year following discharge. Among ischemic stroke patients who were discharged with an elevated BP, we sought to: (1) observe BP control; (2) describe the health care services received; (3) identify potential patient (eg, medication adherence), provider (eg, prescription patterns of anti-hypertensive agents at discharge), and systems (eg, timeliness of post-discharge care) level barriers to obtaining goal BP; and (4) examine the relationship between BP control and utilization of health care services during the 1-year follow-up period.

2 | METHODS

2.1 | Study design and population

This retrospective cohort study included patients who were admitted to a veterans health administration (VHA) hospital with the diagnosis of ischemic stroke during fiscal year 2011, discharged with an elevated systolic blood pressure (SBP) or diastolic blood pressure (DBP), and had at least 1-primary care visit during the 1-year post-discharge. Patients at veteran's affairs (VA) facilities that had at least 10 cases who met the above criteria were included.

2.2 | Data collection

One abstractor, using a data collection tool designed for this study, performed detailed chart review. Electronic medical records were reviewed from the 1-year period post-discharge from the index stroke hospitalization. sociodemographic information, including age at the time of index hospitalization, gender, and race were collected. The number of primary care visits and the date of each visit were also collected. A primary care visit was defined as a visit where the patient was personally seen and examined by a health care provider (either a primary care physician or advanced practitioner) during a scheduled or urgent care visit. Nurse-only visits at the primary care clinic were excluded.

Blood pressure "control" was defined as: SBP < 140 mm Hg and DBP < 90 mm Hg. The average BP was calculated from all BP measurements recorded at primary care visits during the 1-year follow-up period; patients were classified as having controlled BP if the mean was < 140/90 mm Hg or uncontrolled BP if either the mean systolic BP was ≥ 140 mm Hg or the mean diastolic BP ≥ 90 mm Hg.

Data were collected about comorbidities (diabetes mellitus and coronary artery disease), the number of visits to specialty clinics (cardiology, nephrology, neurology, geriatrics, and endocrinology), and visits to ancillary services (nutrition, telehealth, and pharmacy). Progress notes and prosthetics consult data were reviewed to identify the use home BP monitors. The medication list at the time of hospital discharge was obtained from the discharge summary or the pharmacy discharge medication reconciliation list in the electronic medical record system. Mention of any issues related to medication adherence in the provider or pharmacy progress notes during the visits was noted and if there was no mention of any concerns related to non-compliance with medications it was considered that the patient is adherent to medications.

2.3 | Outcomes

Outcomes, including recurrent stroke, transient ischemic attack (TIA), myocardial infarction (MI), subsequent revascularization procedures (eg, percutaneous coronary intervention (PCI) or coronary artery bypass graft surgery [CABG]), carotid stent or carotid endarterectomy (CEA), and death were noted. Similarly, the number of subsequent hospitalizations and emergency department (ED) visits for any reason were recorded.

2.4 | Statistical analysis

SAS version 9.3 was used for all statistical analyses. All tests were 2-sided with a stochastic significance level of $P < .05$ used to identify statistical significance. Means with standard deviations (SD) and medians with interquartile ranges (IQR) were calculated for continuous variables and frequencies for categorical variables. Student's *t*-test was used for comparison of means. The Wilcoxon rank sum test was used to compare medians. Chi-square tests were used for comparison of categorical variables. Logistic regression analysis was performed to study the association of BP control with the number of primary care visits, presence or absence of specialty or subspecialty care, or ancillary follow-up (eg, nutrition, pharmacy, and telehealth). All the adjusting variables were selected a priori. Adjusted odds ratios (OR) and 95% confidence intervals (CI) were examined after adjusting for age, race, history of diabetes, medication adherence, and the number of antihypertensive medications. We used logistic regression to examine whether health care utilization was associated with BP control.

This study received Institutional Review Board approval.

3 | RESULTS

A total of 265 patients from 16 VA facilities were included in the study and had data collected regarding health care utilization and outcomes. BP data were available for 245 patients.

3.1 | Post-stroke BP management

Among the 245 patients with available BP data from the 1-year post-discharge period, the mean BP at discharge was 149.1/83.4 (± 10.7/10.3) mm Hg. The average BP over the 1-year follow-up period was 144.3/81.1 (± 14.9/10.5) mm Hg. Over the course of the 1-year follow-up period 42.0% (103/245), patients had a mean BP of < 140/90 mm Hg.

A minority (56/265, 21.1%) was prescribed more than 2 antihypertensive agents at the time of discharge from the index stroke hospitalization. Of 265 patients, 21.9% had documentation of medication non-adherence by an outpatient provider as an interfering issue (data not shown).

3.2 | Health care utilization

Among the 265 patients in the cohort, only 19 (7.2%) did not attend any primary care visits during the 1-year post-discharge period. The median time to the first primary care visit was 32 days (IQR: 53 days). The mean number of primary care visits in the 1-year follow-up period was 2.9 (± standard deviation, 1.6). Follow-up care occurred with the following provider types during the 1-year post discharge period: neurology (51.7%), cardiology (14.0%), nephrology (7.2%), endocrinology (3.8%), and geriatrics (2.6%; Figure 1A). The patients utilized ancillary services during the same time period, including receiving a home BP monitor (30.6%) and pharmacy (20.0%), nutrition (8.3%), and telehealth (8.0%) consultations (Figure 1B). Overall, less than 50% of post-stroke patients received specialist or ancillary care services after discharge.

3.3 | Outcomes

Among the 265 patients, 10 had a recurrent stroke, 5 had a TIA, 7 had an acute myocardial infarction, 12 had a carotid endarterectomy (CEA), 1 had a carotid stent, and 3 had coronary artery bypass graft (CABG) surgery. Also, all-cause mortality was 3.4% and subsequent ED and hospitalizations occurred in 31.1% and 33.9%, respectively (N = 265).

3.4 | Comparison of patients with controlled versus uncontrolled blood pressure

Among the 245 patients with BP data, there were no statistically significant differences between patients with controlled versus uncontrolled BP with respect to age, gender, race, average number of primary care visits, use of BP monitors, or prescription of more than 2 antihypertensive agents upon discharge (Table 1). Documentation of medication adherence by a treating provider was observed more commonly among patients with uncontrolled, compared with controlled, BP (28.7% vs 15.5%; P = .02).

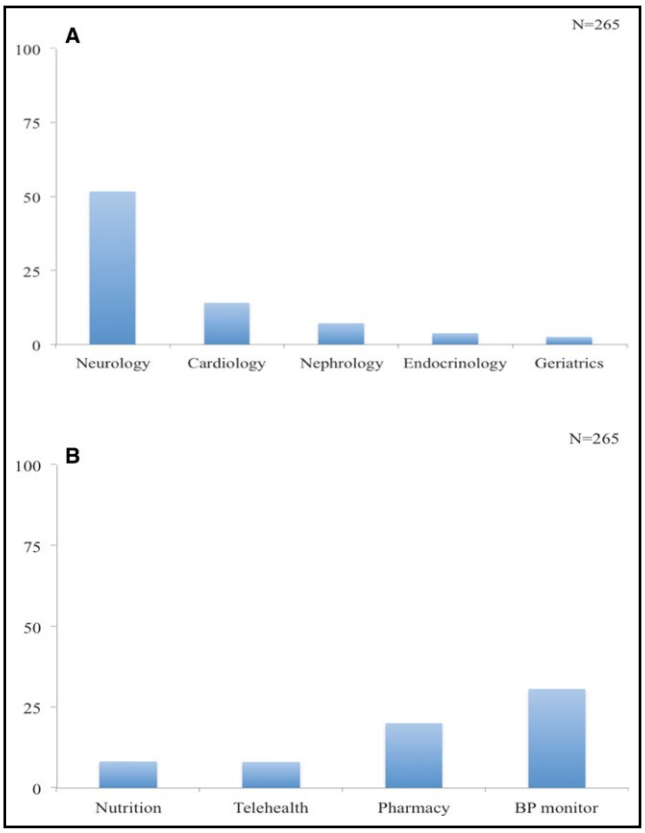

FIGURE 1 (A) The proportion of patients with specialty visits. (B) The proportion of patients with ancillary services

The proportion of patients who received follow-up care in cardiology, nephrology, endocrinology, or geriatrics clinics did not differ between patients with controlled versus uncontrolled BP, however patients with controlled BP were more likely to receive neurology follow-up care compared with patients with uncontrolled BP (62.1% vs 42.3%, P = .002; Figure 2A).

Use of ancillary services did not differ between these 2 groups (Figure 2B).

3.5 | Logistic regression

When examining the association between health care utilization and BP control, neither the number of primary care visits nor the presence of ancillary care follow-up were associated with having controlled BP in unadjusted or adjusted models (Table 2). Specialty care follow-up was associated with having controlled BP in unadjusted (unadjusted OR = 1.9, 95% CI: 1.12-3.28) and adjusted (adjusted OR = 2.2, 95% CI: 1.25-3.96; Table 2) analyses.

4 | DISCUSSION

Among the high-risk population of hypertensive ischemic stroke patients, we report 3 main findings related to patient-, provider-, and

TABLE 1 Comparison of patients with controlled versus uncontrolled blood pressure during 1-year following index stroke hospitalization (N = 245)

Blood pressure	<140/90 mm Hg N = 103	>140/90 mm Hg N = 142	*P* value
Age (y, ±SD)	67.1 ± 10.1	64.9 ± 9.5	.08
Race (%)			
White	66.7	61.7	.54
Black	33.3	37.6	
Others	0	0.7	
Gender (%)			
Male	97.2	99.1	.31
Female	2.8	0.9	
Number of primary care visits (±SD)	2.9 (±1.5)	2.9 (±1.6)	.99
Duration to first primary care visit since index hospitalization (days, median)	31	34	.13
Documentation of medication adherence issues (%)	15.5	28.7	.02
Number of anti-HTN medications at discharge (%)			
None	20.4	18.4	.59
1	35.9	26.9	
2	20.4	34.0	
>2	23.3	20.5	
Recurrent strokes (%)	3.8	4.2	.89
Composite of fatal/non-fatal MI + stroke (excluded TIA) (%)	4.8	7.0	.48

BP, blood pressure; HTN, hypertension; MI, myocardial infarction; SD, standard deviation; TIA, transient ischemic attack.

TABLE 2 Association of health care utilization with blood pressure control

Characteristic	Univariate OR (95% CI)	Adjusted[a] OR (95% CI)
Number of primary visits	1.0 (0.85-1.18)	0.9 (0.84-1.18)
Specialty follow-up	1.90 (1.12-3.28) *P* = .002	2.20 (1.25-3.96) *P* = .006
Ancillary follow-up	1.10 (0.62-1.90)	1.30 (0.70-2.38)

CI, confidence interval; OR, odds ratio.
[a]The logistic regression model adjusted for age, race (white, black, other), past medical history of diabetes (yes/no), number of antihypertensive medications and medication adherence issues (yes/no).

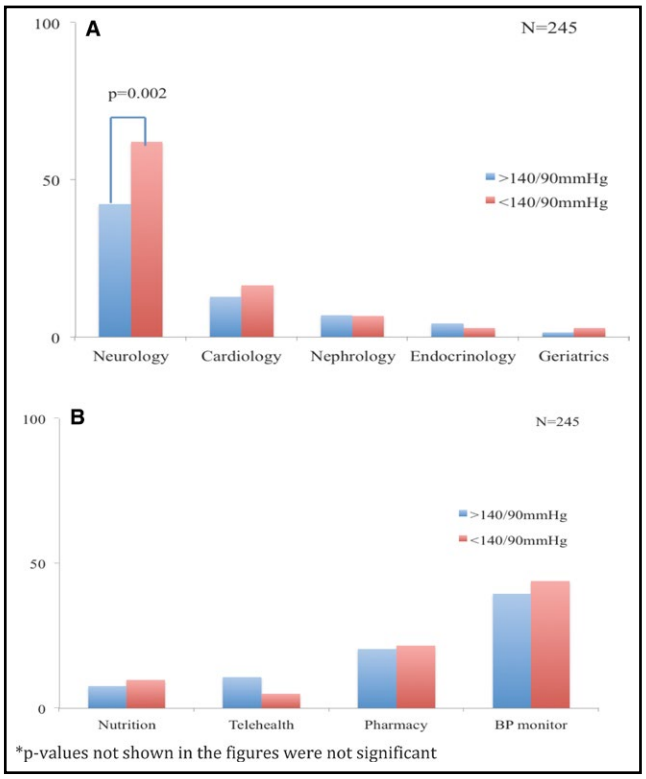

FIGURE 2 (A) Comparison of specialty follow-up between those with controlled versus uncontrolled blood pressure. (B) Comparison of ancillary services between those with controlled versus uncontrolled blood pressure

systems-level barriers related to the delivery of guidance concordant hypertension management. First, we confirmed the high prevalence of continuously elevated BP throughout the 1-year post-stroke period among patients with elevated BP at discharge. Second, the perception of patient medication non-adherence was observed significantly greater in those having uncontrolled BP post-stroke. Third, routinely available and readily accessible health care services that could address adherence and assist in direct management of hypertension were utilized in fewer than 50% of all patients in the year following discharge.

Consistent with American Heart Association/American Stroke Association Ischemic Stroke Prevention Guidelines,[1] it is expected that hypertensive stroke patients, and especially those with patients not at goal BP, would receive intensive medical, as well as lifestyle, modification interventions with the intent to achieve a controlled BP at least within 1 year of discharge. However, the results of this study show those patients with elevated BP at the time of discharge from an ischemic stroke hospitalization continue with poorly controlled BP in the year post-discharge. These findings are similar to a previous retrospective study conducted in 2054 stroke patients, seen within a 6-month period from their index event, among which 673 (32.8%) remained with uncontrolled BP.[12]

We expected that the hypertensive stroke patients in this cohort would receive primary care and specialty and ancillary services, given that a multidisciplinary approach has been shown to effectively lower BP.[13] Although 92.8% of stroke patients did receive at least 1 primary

care visit in the year after discharge, these visits were delayed, with a median duration of 32 days. Given that ancillary services were uniformly available at the VA facilities included in this study, we were surprised by the overall low utilization of ancillary services.[14,15] Future studies should evaluate whether the widespread adoption of the medical home model has increased the use of pharmacy and nutritionist care.

It is noteworthy that follow-up with specialty care was associated with controlled BP. This association was evident even after adjusting for covariates such as number of anti-hypertensive medications, issues with medication adherence, and other comorbidities (eg, diabetes). A majority of this follow-up was with neurology; during the 1-year post-discharge, 51% of patients had at least 1 follow-up visit with a neurologist. Although the available evidence suggests that it might be reasonable to start oral anti-hypertensives as soon as 24-72 hours after onset of stroke symptoms (provided there are no contraindications), some primary care providers may be hesitant to start anti-hypertensive agents without specialist recommendations.[16,17] It is also not uncommon to see that permissible hypertension during the initial 24-hour period post-stroke might be confused as the actual BP goal by some providers well after the period of autoregulation has passed. We speculate that a neurological follow-up may improve the establishment of targets for BP control and reinforce, to primary care providers, the need for BP control. However, further studies are necessary to investigate these speculations.

It is also noteworthy that our findings regarding blood pressure control are similar to the findings of studies regarding other risk factors such as dyslipidemia, high body mass index, and glycosylated hemoglobin (HbA1c) control. One such study done by Cheng et al. followed 99 patients for 1-year post-stroke for control of risk factors. Improvements in risk factor control were detected only in diastolic blood pressure (5 mm Hg) and hemoglobin A1c (0.9%; $P < .05$).[18] Similarly, in the ASPIRE-S (Action on Secondary Prevention Interventions and Rehabilitation in Stroke) study, among the 256 patients followed for 6 months post-stroke, 68% had a BMI > 25 kg/m^2 and 16.4% were still smoking. Almost two-thirds (63.4%) had a blood pressure > 140/90 and 23% had low-density-lipoprotein (LDL) > 2.5 mmol/L. 28% of diabetic patients had HbA1c ≥ 7%.[19]

This study has several limitations. First, the sample size studied was relatively small. Also, during sampling, we decided to exclude centers with less than 10 stroke visits for the fiscal year 2011, since these may not be designated stroke centers. For example, they may be very small critical care access centers where there may not be primary care follow-up facilities. Second, the study focused on veteran patients cared for within VA medical centers, therefore the results may not be applicable to other patient-populations or other health care systems. Third, veterans seek medical care at non-VA facilities and information about this non-VA follow-up care was limited; however, a vast majority of patients discharged from a VHA facility received their primary care services through the VA. Next, although there has been little research examining the utilization (and underutilization) of non-primary care services in relation to post-stroke hypertension management, we cannot directly comment on the role of clinical inertia. Although we report the underutilization of referrals to other specialties and ancillary services, we cannot comment on reasons for this underutilization. For example, a referral to a clinical pharmacist for hypertension comanagement may have been ordered by a primary care provider, but patients may not have scheduled or attended a visit. Finally, since our data was limited to the association between utilization of health care and uncontrolled hypertension post-stroke discharge, we are unable to comment on control of other risk factors such as LDL, HbA1c, and BMI for our sample.

5 | SUMMARY AND CONCLUSIONS

By examining a diverse set of health care services related to hypertension management among post-stroke patients, we identified several patient-, provider-, and systems-level barriers, which should inform the conceptualization of future intervention work designed to improve the delivery of effective post-ischemic hypertension management. Ideally, patients with uncontrolled BP at discharge would have medication intensification at the time of hospital discharge, early post-discharge follow-up, including referral to appropriate specialty services (eg, Neurology), and access to ancillary services. Furthermore, when medication adherence concerns a primary care provider, addressing this in the office and through support of appropriate and readily available referrals and services would be ideal and feasible.

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CONFLICT OF INTEREST

All authors of this manuscript mentioned above have no conflicts of interest for disclosure.

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