Research Report

Prevalence of elevated blood pressure in adult patients presenting to the emergency department

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Abstract

Background and Purpose: For unclear reasons the blood pressure in acute stroke patients is elevated and falls over next few days. Stress in emergency department has been suggested as an etiology. To study this, we compared the prevalence of elevated blood pressure in adult patients presenting to the emergency department (ED) with hypertension related diseases.

Methods: We used data from the 2003 National Hospital Ambulatory Medical Care Survey (NHAMCS). Patients with clinical conditions requiring specific management of elevated blood pressure, namely, stroke, acute coronary syndrome, heart failure and traumatic brain injury were selected using ICD-9CM primary codes. Prevalence of acute systolic blood pressure (BP) ≥140 mmHg and ≥180 mmHg, and, systolic and diastolic BP≥140/90 mmHg and ≥180/110 mmHg were compared across the clinical conditions listed above.

Results: The prevalence of BP≥140/90 mmHg on presentation to ED was significantly higher for stroke patients (78%) compared to patients with heart failure (55%, $p<0.05$) and traumatic brain injury (42%, $p<0.05$). The difference was not significant compared to acute coronary syndrome (63%).

Conclusions: The increased prevalence of abnormally elevated blood pressure in stroke patients presenting to the emergency departments may be explained by higher prevalence of hypertension in these patients but a stroke specific mechanism in the acute period is also possible.

Key words: Acute stroke, blood pressure

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Abbreviations, in the order used in this report.

ED	Emergency Department
NHAMCS	National Hospital Ambulatory Medical Care Survey
ICD-9-CM	International Classification of Disease, 9th Revision, Clinical Modification
BP	Blood pressure
JNC 7	Seventh Report of the Joint National Committee
SEM	Standard error of the mean

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Introduction

In a study of 334 consecutive acute stroke patients Wallace and Levy reported elevated blood pressure in 84%.[1] This number is significantly higher than the fraction of stroke patients with a prior history of hypertension. Multiple studies later demonstrated that blood pressure in patients with acute stroke reduces spontaneously over the next few days. [1-10] The etiology for this elevated blood pressure is unclear. Elevated catecholamine levels,[11] location of infarct,[12] or stroke related injury to hypothalamic-pituitary-adrenocortical axis can possibly explain this acutely elevated blood pressure. Acute mental stress due emergency department setting has been proposed as a major contributor to this acutely elevated blood pressure.[6] This is also suggested by comparable elevation and spontaneous reduction in blood pressure in patients with acute stroke and other surgical conditions.[4] There is a U shaped relationship between blood pressure and stroke outcome.[13-15]

We performed this study to report and compare the emergency room blood pressures of acute stroke patients versus other hypertension related diseases.

Methods

Data source

Data from the 2003 National Hospital Ambulatory Medical Care Survey (NHAMCS) were used in these analyses. The NHAMCS is designed to collect data on the use and provision of ambulatory care services in hospital emergency departments (EDs) using a national probability sample of non-institutional general and short-stay hospitals in the 50 states and the District of Columbia.[16] It contains 663 hospitals and 100 patient visits within each ED over a 4-week reporting period. Data is collected by hospital staff following an in-service test from the United States Bureau of the Census. The database includes patient, hospital and visit characteristics. Data were submitted to and coded centrally by Constella Group Inc, Durham, NC, and subjected to quality control procedures. The dataset contains population weights to produce national estimates considering sampling selection probability and adjustment for nonresponse.

Table 1: ICD-9 inclusion criteria

Conditions	ICD-9 codes	Cases abstracted
Ischemic stroke (IS)	433.xx- 436.xx, 437.xx	100
Intracerebral hemorrhage (ICH)/ Subarachnoid hemorrhage (SAH)	431.xx- 432.xx, 430	16
Acute coronary syndrome (ACS)	410.xx-411.xx	198
Heart Failure (HF)	428.xx	256
Traumatic brain injury (TBI)	800.xx-801.xx, 803.xx-804.xx, 850.xx-854.1, 959.01, 873.xx	442

Study inclusion criteria

All the ED visits for adult patients (18 years and older) with stroke (ischemic stroke, intracerebral and subarachnoid hemorrhage) and other clinical conditions (acute coronary syndrome, heart failure and traumatic brain injury) were selected. Patients with these conditions were identified using International Classification of Disease, 9th Revision, Clinical Modification (ICD-9CM) primary diagnosis codes (see Table 1). Cases with missing blood pressure values were excluded from the analysis.

Categorization of initial blood pressure

To compare the prevalence of elevated blood pressure (BP) between patients with stroke and other conditions, we used following categories of blood pressure: systolic BP ≥ 140 mmHg or ≥180mmHg, BP ≥ 140/90 mmHg or ≥ 180/110 mmHg. In addition, we categorized BP into four categories (<120/80, 120-139/80-89, 140-159/90-99, ≥160/100 mmHg) in accordance to pre-hypertension, stage 1 and 2 hypertension defined by Seventh Report of the Joint National Committee (JNC 7). [17]

Statistical analysis

National estimates of hospitalizations for selected conditions and distribution of patients according to blood pressure categories were determined using NHAMCS weights. Differences in the prevalence of systolic BP ≥ 140 mmHg or BP ≥ 140/90mmHg and systolic BP ≥180 mmHg or BP ≥180/110 mmHg between stroke and other clinical conditions were assessed using logistic regression adjusting for age, sex and time to physician evaluation. In addition, we estimated the mean and standard error of the mean (SEM) of systolic BP for the four clinical conditions adjusted for age, sex, and time to physician evaluation. Values are presented as estimated population percentages, odds ratios and mean ± SEM. We used a p-value of <0.05 and two sided tests to consider for statistical significance. All statistical procedures took into account the sampling design (SAS Institute Inc., Cary, NC).

Table 2: Population characteristic of patient with stroke and other hypertensive conditions

Characteristic	Number or percent
Patients	3,066,710
Stroke	281,830
Ischemic stroke	323,489
Acute coronary syndrome	594,238
Heart failure	743,319
Traumatic brain injury	1,169,111
Mean age, years ± SEM	58.5±0.88
Age distribution (%)	
<25	9.8
25-44	17.7
45-64	27.8
65-74	15.1
75+	29.6
Female (%)	48.1
Race/Ethnicity	
White only	72.9
African American	15.1
Hispanic	9.1
Other	2.9
Median time to physician evaluation, min (min-max)	20 (0-360)

Abbreviation used: SEM=Standard error of the mean

Results

Records of approximately 282,000 patients with stroke were available in the NHAMCS in 2003. Number of patients for other clinical conditions together with patient characteristics is described in Table 2. Mean age of patients was 58.6 years, 48% were women and the majority of patients were white, 73%. Median time to physician evaluation was 20 minutes (0-360 minutes).

The Prevalence of SBP/DBP ≥ 140/90 mm/Hg in patients with stroke was 78%. Prevalence of systolic BP ≥ 140 mmHg, or BP ≥ 140/90 mmHg was significantly higher in patients with stroke compared to patients with heart failure (p<0.05) and traumatic brain injury (p<0.05) (see Table 3). There was a non-significant higher prevalence of systolic BP≥ 140 mmHg or BP ≥ 140/90 mmHg in acute stroke patients compared to patients with acute coronary syndrome. When a cut-off of ≥180 mmHg was used for systolic BP or ≥180/110 mmHg for blood pressure, there was no significant difference among prevalence of elevated BP, acute coronary syndrome and heart failure. Odds ratios are presented in Table 3. The distribution of hypertension stages according to JNC 7 are presented in Figure 1. Mean systolic BP was higher for stroke when compared to the other clinical conditions and difference reached statistical significance (p-value <0.05) for heart failure and traumatic brain injury (see Figure 2).

Prevalence of systolic BP ≥140 mmHg was higher in patients with intracerebral or subarachnoid hemorrhage (82%) than ischemic stroke (76%). Similarly prevalence of BP ≥ 140/90 mmHg for intracerebral or subarachnoid hemorrhage patients (86%) was higher than ischemic stroke (77%). Comparisons of prevalence of systolic BP ≥140 mmHg and BP ≥ 140/90 mmHg

Table 3: Prevalence of different blood pressure categories with respect to patients with stroke adjusted for age, sex, and time to physician evaluation

Hypertensive condition	Prevalence	Odds Ratio (95% Confidence Interval)	Prevalence	Odds Ratio (95% Confidence Interval)
	SBP >= 140 mmHg		*SBP/DBP >=140/90 mmHg*	
Stroke	77%	Ref	78%	Ref
Acute coronary syndrome	59%	0.5 (0.3-1.0)	63%	0.6 (0.3-1.2)
Heart failure	54%	0.3 (0.2-0.7)*	55%	0.3 (0.2-0.7)*
Traumatic brain injury	37%	0.3 (0.2-0.6)*	42%	0.3 (0.2-0.6)*
	SBP >=180 mmHg		*SBP/DBP >=180/110 mmHg*	
Stroke	26%	Ref	29%	Ref
Acute coronary syndrome	15%	0.6 (0.2-1.8)	17%	0.6 (0.2-1.6)
Heart failure	18%	0.6 (0.3-1.3)	20%	0.6 (0.3-1.2)
Traumatic brain injury	5%	0.3 (0.1-0.8)*	6%	0.2 (0.1-0.6)*

*P-value<0.05

between stroke subtypes did not reach statistical significance due to small sample size for intracerebral hemorrhage and subarachnoid hemorrhage subgroup.

Discussion

In this analysis, the proportion of patients with systolic BP ≥ 140 mmHg or BP ≥140/90 mmHg was significantly higher in acute stroke patients when compared to patients with other acute medical conditions. When higher cut-off value for blood pressure was used, the difference with acute cardiac conditions remained but did not reach statistical significance.

Britton et al[4] studied the natural course of elevated blood pressure in a case-control design. BP ≥ 170/100 mm Hg was noted in 69% of acute stroke patients compared to only 36% of patients who were admitted for acute surgical conditions. The controls were age and sex matched, but since they were admitted for non cardiovascular emergencies, the prevalence of history of hypertension was significantly lower (26%) in them than in acute stroke patients (46%). We compared the prevalence of elevated blood pressure between acute stroke patients and other cardiovascular conditions. The prevalence of history of hypertension in patients with acute coronary syndrome (28-58%)[18] and congestive heart failure (50-70%)[19] is expected to be similar to the acute stroke patients (60-75%)[20, 21]. In addition, the ED environment should be equally stressful for each condition. Thus any difference in the prevalence of elevated blood pressure is likely reflective of a stroke specific phenomenon. We also studied the prevalence of elevated blood pressure in patients with traumatic brain injury. This was higher (37%) than the prevalence of hypertension in general population (29%).[22] This could however be either secondary to response to stress or a central response.

The etiology for elevated blood in acute stroke remains unclear. Involvement of autoregulatory centers in brain stem has been noted as a mechanism for increased blood pressure in stroke patients .[12] However, increased blood pressure has been noted regardless of the region of brain involved.[23] Myers et al measured the plasma catecholamine levels in 74 patients with cerebral infarction and 33 control subjects who were erroneously admitted for suspicion of stroke. The levels of catecholamines were elevated in patients with stroke compared to control subjects.[11] Although they noted a correlation between blood pressure and norepinepherine in the control group, they did not find any such correlation in the stroke group. They suggested that brain infarct has altered the relationship between blood pressure and catecholamines. Recently, Strittmater demonstrated that the elevated cardiovascular parameters do correlate with elevated levels of catecholamines.[23]

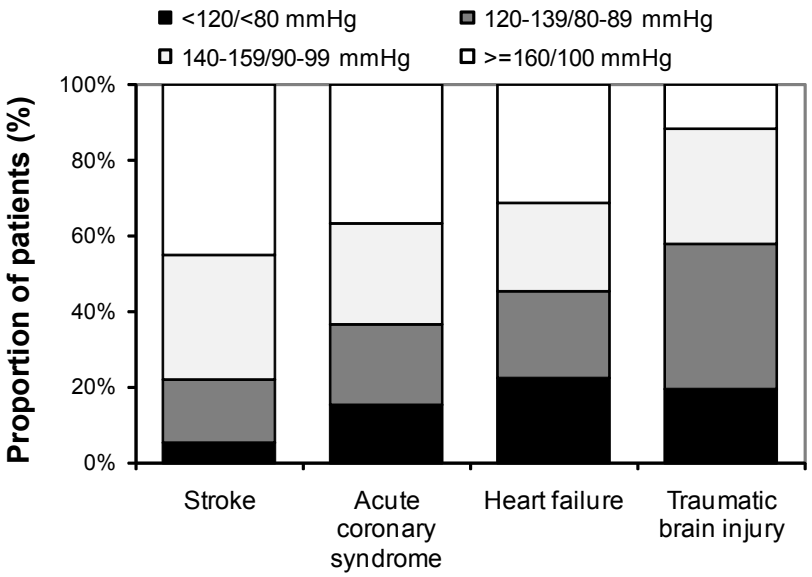

Figure 1: Distribution of blood pressure according to JNC-7 categories for stroke and other clinical conditions

Carlberg et al studied predictors of blood pressure elevation in 843 stroke patients who presented up to 168 hours after stroke.[6] The blood pressure levels were similar on hospital admission regardless of duration of symptoms, and suggested acute mental stress response to hospital environment. In our study, the prevalence of elevated blood pressure in stroke or other acute medical conditions is more than what is expected from prevalence of hypertension. This finding

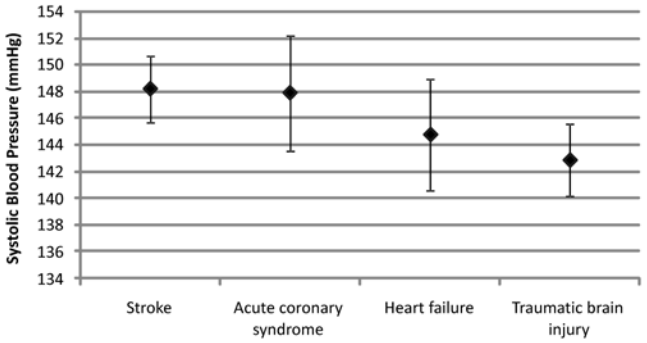

Figure 2: Mean systolic blood pressure ± standard error for stroke an other clinical conditions. p-value <0.001 for overall difference.

possibly supports acute stress as an etiology for elevated blood pressure in hospital environment.

This study has several limitations. Important clinical information including the history of hypertension, severity of condition, duration from the time of onset and follow-up blood pressures was not available and thus we cannot eliminate the effect of different prevalence of hypertension in patients with the clinical conditions analyzed. We used primary ICD-9-CM codes to identify stroke patients, which has a sensitivity of 84% and a true positive rate of 83%.[5] Small number of patients for stroke subtypes did not allow us to further analyze the data.

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