ECRONICON OPEN ACCESS

EC CARDIOLOGY
Research Article

Prevalence of Intern-Arm Blood Pressure Difference among Patients with Ischemic Stroke

Zimmer Zhaneta*, Pinder Thomas and Mahaparale Shivaling

Department of Internal Medicine, Providence Hospital, Washington DC, USA

***Corresponding Author:** Zimmer Zhaneta, Department of Internal Medicine, Providence Hospital, Washington DC, USA.

Received: April 09, 2019; **Published:** May 16, 2019

Abstract

Background: The accurate assessment of blood pressure (BP) is vital for correct diagnostic and therapeutic decisions. There are several recognized anatomical abnormalities and conditions which may lead to a disparity in BP between the two arms include aortic dissection, coarctation of the aorta, peripheral vascular disease, and unilateral neurological and musculoskeletal abnormalities. Although the underlying mechanism of such difference is not fully known, the presence of large inter-arm BP difference has been shown to be independently associated with cardiovascular disease and mortality.

Objectives: The aim of the study is to determine the prevalence of inter-arm systolic blood pressure (SBP) difference in a stroke population and to show that the presence of intern-arm systolic pressure difference > 10mmHg is a strong independent marker that associates with cerebral atherosclerosis and development of stroke.

Material and Methods: The study was conducted on a sample of patients aged 18 and older. BP was recorded simultaneously in both arms using the non-invasive method. Intern-arm BP difference was defined as the Right arm minus the Left arm pressure for systolic blood pressure (SBP). The presence of the cerebrovascular event (stroke) was counted based on the interpretation/reading of brain computed tomography (CT) and/or brain magnetic resonance (MRI) done during the admission period. The primary outcome in the study was the total number of cerebrovascular accidents (CVA), defined as the total number of ischemic stroke developed during the current hospitalization.

Results: In comparison to the group w/SBP < 10 (9.4%), a greater percentage (38.1%) of those in the group w/SBP > 10 experienced CVA. There was a greater percentage of smokers within the group of patients w/SBP > 10 compare to the group of patients w/SBP < 10. The group of patients w/ SBP > 10 statistically significant differed from the group of patients w/SBP < 10 in terms of CVA occurrence, $\chi^2(1) = 16.30$, $p < .001$. The odds of patients w/SBP > 10 increased by 5.91, 95% CI [2.24, 15.62].

Conclusion: The study shows that a difference in SBP of 10 mmHg or more between arms, might help to identify patients who need further cerebrovascular assessment, and could be a useful indicator of a risk of cerebrovascular disease and death. This study supports the potential value of identifying the inter-arm systolic blood pressure difference as a simple, independent risk factor of increased cerebrovascular risk and stroke.

Keywords: *Intern-Arm Blood Pressure; Systolic Blood Pressure; Computer Tomography; Brain Magnetic Resonance; Cerebrovascular Accidents*

Introduction

Hypertension is associated with increased mortality and morbidity from cardiovascular, cerebrovascular and renal disease. The accurate assessment of blood pressure (BP) is vital for correct diagnostic and therapeutic decisions [1]. Differences in systolic blood pressure

between the arms can predict an increased risk of cardiovascular events and all-cause mortality over 10 years in people with hypertension [2,3]. The new guidelines stress the importance of using proper technique to measure blood pressure. Upon initial assessment blood pressure should be measured in both arms, and if there is a difference, the arm with the higher pressure should be used for all future measurements [4].

There are several recognized anatomical abnormalities and conditions which may lead to a disparity in BP between the two arms. These include aortic dissection, coarctation of the aorta, peripheral vascular disease, and unilateral neurological and musculoskeletal abnormalities. It is important to underline that concomitant subclavian stenosis might lead to an underestimation of the true systemic blood pressure. Related with this study statement affirmed the clinical need for the measurement of inter-arm blood pressure differences in patients undergoing carotid revascularization, especially in post-operative phase in the prevention of cerebral hyperperfusion [5]. However, the question remains as to whether individuals and patients without the above-mentioned conditions have different BP in the two arms, and if so, whether there are any other factors that makes this difference more or less likely.

Review of the literature shows that a difference in SBP of 10 mmHg or more between arms, might help to identify patients who need further vascular assessment [3] and could be a useful indicator of a risk of vascular disease and death. Several studies have shown negative correlations of magnitude of inter-arm difference with ankle-brachial index [6]. Recent paper demonstrated that ABI < 0.9 and high left ventricular mass were independently associated with an inter-arm SBP difference > 10 mmHg. According to this study, detection of an inter-arm difference may provide a simple method of detecting patients at increased risk of atherosclerosis and left ventricular hypertrophy [7]. These findings strengthen the hypothesis that the difference is due to peripheral vascular disease, and this may represent a sign of clinical importance.

Aim of the Study

The aim of our study is to determine the prevalence of inter-arm SBP difference in a stroke population and to show that the presence of inter-arm systolic pressure difference >10mmHg is a strong independent marker associates with cerebral atherosclerosis and development of stroke.

Material and Methods

Study design

A cross-sectional study.

Study population

The study was conducted on a sample of patients at the Providence Hospital, Washington DC. All patients aged 18 and older.

Exclusion criteria

Patient with Aortic dissection, Subclavian Steal Syndrome, Coarctation of Aorta; Patient with ESRD – HD with AV Fistula or graft

Variables

All participants were in supine position during measurement of their BP. In addition to BP measurements, demographic date included age and sex. BP was recorded simultaneously in both arms using the non-invasive method. It was done using digital DINAMAT V100- General Electric. One observer conducted all BP measurements. In case of failing of recording the BP at first attempt, the test was repeated after 2 minutes of rest. After BP obtained in one of the arms, the BP machine and cuffs were transferred to the opposite arm and the process was repeated after a 2 minutes interval. BP was taken for all patients between 8 - 9 am. Two sets of bilateral BP measurements were obtained for each patient. All patients were outside of the permissive hypertension period required for ischemic stroke.

Intern-arm BP difference was defined as the Right arm minus the Left arm pressure for systolic blood pressure (SBP). In the study, the presence of a large inter-arm difference (IAD) was defined as the absolute inter-arm difference of SBP > 10 mmHg, which is frequently use cutoff in previous studies for large IAD.

The presence of the cerebrovascular event (stroke) was counted based on the interpretation/reading of brain computed tomography (CT) and/or brain magnetic resonance (MRI) done during the admission period.

The primary outcome in the study was the total number of cerebrovascular accidents, defined as the total number of ischemic strokes developed during the current hospitalization before the current hospital admission.

Statistical analysis

We used descriptive analysis. Will calculated prevalence of inter-arm blood pressure difference along with 95% CI and odds ratios. Data was expressed as percentages of individuals with systolic IAD and mean ± standard deviation for inter-arm difference in systolic blood pressure. The Z-test was used to identify the statistical significance of mean differences of systolic blood pressure between left and right arm, while one-way analysis of variance (ANOVA) was used to identify the significance of mean systolic blood pressure differences in left arm and right arm at different inter-arm blood pressure difference levels. The probability value $p < 0.05$ was considered as significant. Comparisons between IABP difference ≥ 10 mm Hg and factors including history of hypertension, diabetes, smoking, and obesity, categorized age groups and gender were examined using chi-squared test.

Results

The findings in table 1 reveal that 97 (60.2%) of the patients had an SBP differential that was greater than 10. The two SBP groups did not differ in terms of gender, hypertension, diabetes, and age. But the two groups differed significantly in terms of CVA (findings will be described in detail in the next section) and in terms of the proportion of smokers ($p = .018$). There was a greater percentage of smokers within the group of patients whose SBP differential was greater than 10.

	Whole Sample (N = 161)		**SBP < 10 (N = 64)**		**SBP > 10 (N = 97)**			
Variables	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**df**	**χ^2/t**
Gender								
Male	75	(46.6)	33	(51.6)	42	(43.3)	1	.74
Female	78	(48.4)	29	(45.3)	49	(50.5)		
CNS								
No	118	(73.3)	58	(90.6)	60	(61.9)	1	16.30***
Yes	43	(26.7)	6	(9.4)	37	(38.1)		
HTN								.00
No	86	(53.4)	34	(53.1)	52	(53.6)	1	
Yes	75	(46.6)	30	(46.9)	45	(46.4)		
Diabetes								
No	111	(68.9)	47	(73.4)	64	(66.0)	1	1.00
Yes	50	(31.1)	17	(26.6)	33	(34.0)		
Smoker								
No	114	(70.8)	52	(81.3)	62	(63.9)	1	5.60*
Yes	47	(29.2)	12	(18.8)	35	(36.1)		
Obese								
No	113	(70.2)	47	(73.4)	66	(68.0)	1	.54
Yes	48	(29.8)	17	(26.6)	31	(32.0)		
Age M(SD)	64	(17.5)	63	(16.8)	64	(18.0)	159	-.32

Table 1: *Frequencies and percentages of the study variables.*

** p < .05. ** p < .01. *** p < .001.*

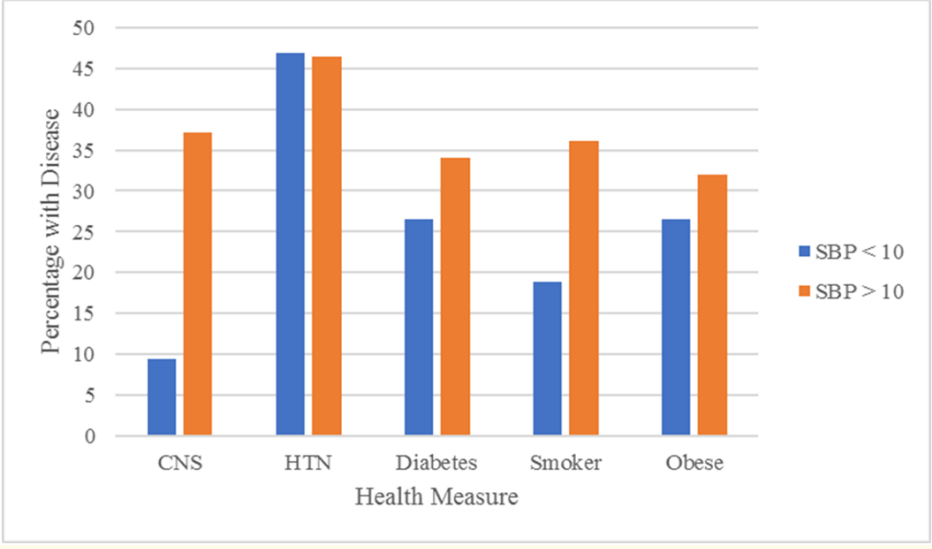

Figure 1: *Percentage of patients with disease within the SBP less than 10 and SPB greater than 10 groups.*

Testing the relationship between SBP differential >10 and occurrence of CVA

As noted in the previous section, the group of patients whose SBP differed by more than 10 differed from the group of patients whose SBP differed by less than 10 in terms of CVA occurrence, $\chi^2(1) = 16.30$, $p < .001$. In comparison to the latter group (9.4%), a greater percentage (38.1%) of those in the former group experienced CVA. Per the logistic regression findings in table 2, after adjusting for age, gender, hypertension, diabetes, smoking, and obesity, the odds of patients whose SBP differed by more than 10 increased by 5.91, 95% CI [2.24, 15.62]. Note that none of the control variables significantly predicted the likelihood of CVA.

					95% CI for OR	
Variables	**B**	**SE**	**Wald**	**OR**	**Lower**	**Upper**
Age	.02	.01	3.15	1.02	1.00	1.05
Female	-.40	.41	.98	.67	.30	1.49
Hypertension	.03	.47	.00	1.03	.41	2.59
Diabetes	-.34	.51	.46	.71	.26	1.92
Smoker	.49	.45	1.19	1.64	.68	3.96
Obese	.18	.48	.14	1.20	.47	3.05
SBP greater than 10	1.78	.50	12.83***	5.91	2.24	15.62

Table 2: *Logistic regression results for the CNS model (N = 161).*

Note. Reference group was male, no hypertension, no diabetes, non-smoker, not obese, and SBP less than 10. Overall model $\chi^2(7) = 22.22$, $p = .002$.

** p < .05. ** p < .01. *** p < .001,*

Testing the differences between patients who experienced CVA and patients who did not experience CVA within the group of patients with an SBP differential > 10

The findings in table 3 reveal that, within the group of patients with an SBP differential greater than 10, patients that did not experience CVA did not differ significantly from patients that experienced CVA in terms of gender, HTN, diabetes, smoking status, obesity, and age.

	No CNS (N = 56)		Had CNS (N = 35)			
Variables	**n**	**(%)**	**n**	**(%)**	**df**	**χ2/t**
Gender						
Male	25	(44.6)	17	(48.6)	1	.13
Female	31	(55.4)	18	(51.4)		
HTN						
No	34	(56.7)	18	(48.6)	1	.44
Yes	26	(43.3)	19	(51.4)		
Diabetes						
No	39	(65.0)	25	(67.6)	1	.07
Yes	21	(35.0)	12	(32.4)		
Smoker						
No	42	(70.0)	20	(54.1)	1	2.52
Yes	18	(30.0)	17	(45.9)		
Obese						
No	42	(70.0)	24	(64.9)	1	.28
Yes	18	(30.0)	13	(35.1)		
Age M (SD)	62	(17.8)	67	(18.1)	95	-1.44

Table 3: *Frequencies and percentages of the study variables within the group of patients with an SBP differential greater than ten.*

** p < .05. ** p < .01. *** p < .001.*

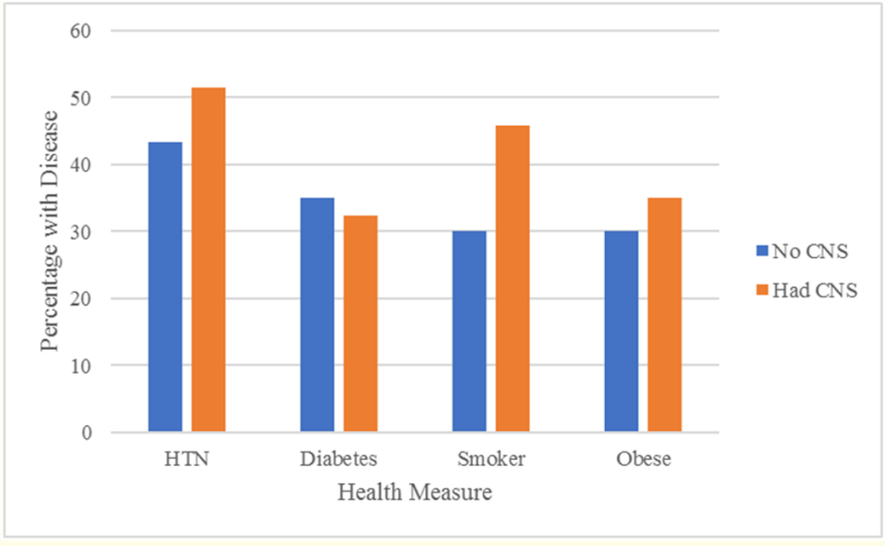

Figure 2: *Percentage of patients with disease within the group of patients who did not have CVA and the group of patients who had CVA (only within the SPB greater than 10 group).*

Discussion

Blood pressure difference between arms is a common phenomenon which could be observed in various populations. However, the underline mechanism of such difference between arms is still unclear. There is an assumption that the difference of blood pressure is due

to the atherosclerotic stenotic lesions [8]. Previous studies have focused on identification of high risk groups for future cardiovascular events. The findings clearly showed that an inter-arm difference may also be predictive of long term mortality in acute vascular events such as acute ischemic stroke [9].

The present study found SBP inter-arm difference of >10 mmHg in 97 (60.2%) of the patients. The two SBP groups did not differ in terms of gender, hypertension, diabetes, and age. However, a difference in systolic blood pressure between arms of 10 mm Hg was associated with statistically significant increased CVA occurrence. None of the control variables significantly predicted the likelihood of CNS. Within the group of patients w/ SBP >10, patients that did not experience CVA did not differ significantly from patients that experienced CVA in terms of gender, HTN, diabetes, smoking status, obesity, and age.

Conclusion

The stroke population presents a high-risk group for future cardiovascular and cerebrovascular events and therefore estimation of inter-arm SBP difference as a predictive tool may assist with further secondary stroke prevention. The study shows that a difference in SBP of 10 mmHg or more between arms, might help to identify patients who need further cerebrovascular assessment, and could be a useful indicator of a risk of cerebrovascular disease and death. This study supports the potential value of identifying the inter-arm systolic blood pressure difference as a simple, independent risk factor of increased cerebrovascular risk and stroke.

Bibliography

1. Deirdre L., *et al*. "Inter-arm differences in blood pressure: when are they clinically significant?" *Journal of Hypertension* 20.6 (2002): 1089-1095.

2. Christopher C., *et al*. "The difference in blood pressure readings between arms and survival: primary care cohort study". *British Medical Journal* 344 (2012): e1327.

3. Christopher C., *et al*. "Association of a difference in systolic blood pressure between arms with vascular disease and mortality: a systematic review and meta-analysis". *The Lancet* 379.9819 (2012): 905-914.

4. Rajiv A., *et al*. "Prognostic Significance of Between-Arm Blood Pressure Differences". *Hypertension* 51.3 (2008): 657-662.

5. Huibers A., *et al*. "Upper Extremity Blood Pressure Difference in Patients Undergoing Carotid Revascularization". *European Journal of Vascular and Endovascular Surgery* 53.2 (2017): 153-157.

6. Jesper M and Niels W. "Interarm Difference in Blood Pressure: Reproducibility and Association with Peripheral Vascular Disease". *International Journal of Vascular Medicine* (2014): 841542.

7. Ho-Ming Su., *et al*. "Association of Interarm Systolic Blood Pressure Difference with Atherosclerosis and Left Ventricular Hypertrophy". *PLoS One* 7.8 (2012): e41173.

8. Yan W., *et al*. "Association of Inter-Arm Blood Pressure Difference with Asymptomatic Intracranial and Extracranial Arterial Stenosis in Hypertension Patients". *Scientific Reports* 6 (2016): 29894.

9. Kim J., *et al*. "Interarm blood pressure difference and mortality in patients with acute ischemic stroke". *American Academy of Neurology* 80.16 (2013): 1457-1464.

Volume 6 Issue 6 June 2019