ELEVATED INTER-ARM BLOOD PRESSURE DIFFERENCE: LEVELS AND CORRELATES AMONG STROKE SURVIVORS

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Abstract

Background: Differences could exist in blood pressure measurement obtained from both arms, and it is deemed abnormal when it is equal to/ greater than 10mmHg. The elevated interarm blood pressure differences (IABPDs) have been associated with an increased risk for cardiovascular dysfunction.

Objectives: This study aimed at determining the levels and correlates of elevated IABPDs in systolic and/or diastolic values of stroke survivors.

Methods: Sixty-one stroke survivors (27males and 34females) were recruited from the stroke unit of the Physiotherapy Clinic at the University of Port Harcourt Teaching Hospital, Nigeria. BP values were measured in both arms with the patient in a sitting position. An interval of 5 minutes was observed before measuring from the other arm. Data obtained were analyzed and summarized, using descriptive statistics of frequency and percentage. Inferential statistics of Chi-Square was used to determine significant differences between variables. Level of significance was set at $p < 0.05$.

Results: Findings revealed elevated IABPDs in 82% of the participants; with the greatest difference noted to be 30mmHg. There was an association between IABPDs and Gender (p=036), BMI (p=041), and affected arm (0.017) respectively.

Conclusions: Elevated IABPDs was common among the stroke survivors; with discrete higher systolic and diastolic BP values that elicited such IABPDs derived from both arms. Females had twice as much elevated IABPDs than the male participants. Such elevated IABPDs shows an increased risk for cardiovascular diseases hence it is vital to observe it among patients with diseases like stroke which can reoccur. Overall, this measure will help all health care professionals to optimally monitor and care for stroke survivors.

Keywords: IABPDs, Stroke Survivors, Blood Pressure

Introduction

Differences could exist in systolic and/or diastolic blood pressure values obtained from measurements on both arms. Such inter-arm blood pressure difference (IABPD) is commonly observed clinically but is considered elevated and also significant when it is equal to or above 10 mmHg.

The elevated inter-arm blood pressure differences (IABPDs) have been associated with an increased risk for cardiovascular disorder or dysfunction and increased cardiovascular mortality[1]; emphasizing attention to such variables towards safe and optimal management of disease like stroke which is likely to reoccur as systolic and/or diastolic high blood pressure values remains the most modifiable risk factor for repeat/recurrent stroke[2]. It is important to observe these differences in the blood pressure measurement of stroke patients especially during their initial assessment and as they are undergoing treatment. It is recommended that blood pressure should be taken from both arms to be properly informed as well as to detect any elevated differences[3,4].

According to Yoonkung et al.[5], differences in systolic and/or diastolic blood pressure has been reported in general population (4%), diabetic patients (7%) and stroke patients (10%)

Muscle tone also influences the value of the systolic and/or diastolic blood pressure. In paretic patients, the flaccidity or spasticity of a muscle influences the value of the systolic and diastolic blood pressure on affected arm by either increasing or decreasing blood pressure[4]. However, there was agreement that the tonicity of muscle is a predictor of IABPDs which could be as a result of increased compressibility of hypotonic muscles by the sphygmomanometer cuff resulting in the partial occlusion of the brachial artery or as a result of the hypertonic muscles resisting the compressibility of the sphygmomanometer cuff in spastic arms[6-8].

Differences in blood pressure can cause misinterpretation and mismanagement of high blood pressure when not recognized[3]. The prevalence of IABPD as reported in Clark et al[9] was usually present in the presence of hypertension. Studies have shown an existence of inter-arm blood pressure values difference but with majority of them not later than 2 decades and only one work carried out in Nigeria[2].

Methods

Research Design

A cross-sectional descriptive design was used for this study. Consecutive sampling was used in recruiting participants in the study.

Participants

The participants in this study were stroke survivors attending physiotherapy outpatient clinic in University of Port Harcourt Teaching Hospital, Rivers State. The inclusion criteria for this study were patients with first episode of stroke within one year, stroke patients with absence of upper extremity amputation, patients that are ≥ 18 years of age and with ability to sit upright with minimal support. Patients that did not meet the criteria were excluded from the study. A total of 61 stroke survivors aged between 30 and 80 years comprising of 34 females and 27 males consented to participate in the study.

Study setting

This study was conducted at the University of Port Harcourt Teaching Hospital (UPTH) from June-October 2021

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Procedure

Ethical approval for the study was obtained from the University of Port Harcourt Teaching Hospital ethical committee. Stroke survivors attending physiotherapy clinic in the hospital were approached during their clinic days and their consents were sought and obtained before recruiting them in the study. A proforma containing the sociodemographic data of the patients was administered by the researchers to the participants. Patients' clinical assessments (muscle tone, duration of stroke and side of affectation) were obtained from the case notes of patients. The participants body mass index (BMI), stage of recovery, muscle bulk, cause of stroke, blood pressure measurements (using manual sphygmomanometer) were obtained during patients' review by the researchers.

Measurements

Body Mass Index: Body mass index was measured using a stadiometer for the height and weighing balance for the body weight. Error due to parallax was avoided during the reading on both the stadiometer and weighing balance by ensuring vertical eye contact on the measuring apparatus.

Blood Pressure Measurement: The blood pressure was measured using a standardized manual sphygmomanometer and a stethoscope. All blood pressure measurements were taken with the patient in a sitting position, back supported and the feet flat on the floor with legs uncrossed. The arm was bare and supported using pillows placing the antecubital fossa at the heart level the cuff placed such that the lower the lower edge is placed at least 2-3cm above the antecubital fossa to allow space for placement of the chest piece (bell or diaphragm) of the stethoscope. Correct cuff size was used for each

participant such that the bladder encircles 80% of the arm and placing the midline of the bladder cuff over the brachial artery in the antecubital fossa. During the blood pressure measurement, the arm that was used for initial measurement in each participant was selected randomly and three recordings of the blood pressure was taken for each arm, at 7 minutes interval respectively. The mean for each for set of the three recordings were calculated and used for data analysis. Deflation rate of the pump was 2-3mm per second.

Data Analysis

Descriptive statistics of frequency and percentages summarized the age, gender of the stroke survivors, selected clinical characteristics of stroke (tonicity, side affected, BMI, stage of stroke, differences in muscle bulk and duration of stroke) inherent in the participants. Inferential statistics using Chi-Square test was used in determining the association between IABPDs and age, sex and clinical characteristics of the participant such as BMI, affected arm, stage of stroke, duration of stroke and difference in muscle bulk. A P-value of < 0.05 was considered statistically significant.

Results

Table 1 shows the demographic profile and clinical characteristics of the participants. The 61 participants comprise of 27 male (44.3%) and 34 female (55.7%); within the age group of 30–40 (11.5%), 41-50 (23%), 51-60 (32.8%), 61-70 (27.9%) and 71-80 (4.9%). Ischaemic and hemorrhagic type of stroke comprises of 35 (57.4%) and 26 (42.6%) of the population respectively with arm affection more on the left 31(50.8%) than on the right 30 (49.2%). It further revealed that 20 (32.8%) and 9 (14.8%) of the participants are overweight and obese respectively. Participants with stroke for greater than 7 months accounted for 52.7% of stroke survivors

Among the 61 participants recruited for the study, 50(82%) of them have elevated interarm blood pressure differences and 11(18%) showed not to have an elevated interarm blood pressure differences. Most participants (82%) were observed to have elevated interarm blood pressure differences while this observation was not noted in other patients (18%).

The association between elevated IABPD and age, sex and BMI is presented in Table 2. A significant association existed between elevated IABPD and sex ($p=0.036$). Elevated IABPD was highest (55.7%) among the female gender and lowest (44.3%) among the male gender. A significant association was also observed between elevated IABPD and BMI ($p=0.0.041$). Notably, 7 (11.5%) were underweight, 25(41%) normal weight, 20(32.8%) overweight and 9(14.8%) obese. In contrast, there was no significant association between elevated IABPD and age ($p=0.218$). A significant association was observed between elevated IABP and stage of stroke ($p <0.000$). For differences in muscle bulk ($p=0.566$) and duration of stroke ($p=0.432$), no significant association were observed. A significant association was also observed between elevated IABPD and affected arm ($p=0.017$).

Table 1: Demographic and clinical characteristics of participants

Variables	Frequency(n)	Percentage (%)
Age		
30-40	7	11.5
41-50	14	23.0
51-60	20	32.8
61-70	17	27.9
71-80	3	4.9
Sex		
Female	34	55.7
Male	27	44.3
Affected Arm		
Left	31	50.8
Right	30	49.2
Type of stroke		
Ischemic	35	57.4
Hemorrhagic	26	42.6
Stage of stroke		
Flaccid	13	21.3
Spasticity appears	4	6.6
Spasticity increases	17	27.9
Spasticity decreases	6	9.8
Complex movement combinations	4	6.6
Spasticity decreases	13	21.3
Normal functions return	4	6.6
Duration of stroke		
0-3 months (acute)	23	37.7
3-6 months (subacute)	6	9.8
> 6months (chronic)	32	52.5
BMI		
<18.5 (Underweight)	7	11.5
18.5-24.9 (Normal)	25	41.0
25.0-29.9 (Overweight)	20	32.8
30.0 upwards (Obese)	9	14.8

Table 2: Elevated Inter-arm differences

	Frequency	Percentage (%)
YES	50	82%
NO	11	18%

Table 3: Elevated Inter-Arm Blood Presure Difference

FACTORS	**X^2**	**p-value**
Age	5.760	0.218
Sex	4.407	0.036*
BMI	8.276	0.041*
Stage of stroke	24.168	0.000*
Diff. in muscle bulk	1.140	0.566
Duration of stroke	1.680	0.432
Affected arm	5.720	0.017*

***** Indicates significance at $p<0.05$

Discussion

The interarm blood pressure difference of ≥ 10 mmHg was noted in 82% of the participants. Verberk et al.[10], in their study stated that method of inter-arm difference (IAD) performance had a significant influence on its prevalence. Cassidy & Jones[11] in their study also observed wide range of interarm blood pressure differences. Interarm blood pressure difference ≥ 10mmHg shows an increased risk for cardiovascular diseases, including increased cardiovascular disease related mortality and morbidity and all-cause mortality. Among the study participants, there are more female stroke patients than their male counterpart. This could be due to the unmonitored and poorly treated pregnancy induced hypertension, hypercholesterolemia and gestational diabetes. Maduagwu et al[2] and Dewar et al [8] in their study also recorded female preponderance. Conversely, Orme et al[12] and Clark et al[9] in their study found no significance association between elevated IABPD with gender. Elevated IABPD was significantly observed in the affected arms of the participants which could be as a result of the variations in muscle tone between the affected and unaffected limb. This corresponds to a study by Yagi et al. [13], Dewar et al. [8], and Uijen [4] where elevated IABPD was significantly observed in the paretic limb than in the nonparetic limb. Age, difference in muscle tone and duration of stroke were found in this study to have no significance association with elevated IABPD between the affected and unaffected arm. This concurs with the finding of Maduagwu et al.[2], Uijen [4], Orme et al.[12] and Dewar et al[8] although reason(s) for this could not be ascertained. Conversely, Lane et al [14] found that age can be a significant predictor of elevated inter-arm BP differences for the general population. However, with increase in age, loss of vascular elasticity with a concurrent increase in arterial resistance to compression is usually common which might account for differences in BPs when taken in both arms [14].

Body mass index (BMI), stage of stroke and the arm affected were found in this survey to have a significant effect on elevated interarm blood pressure differences. Schwartz et al[15] noted that increased body mass index (BMI) is associated with elevated systolic IADs. In paretic patients, the flaccidity or spasticity of a muscle influences the value of the systolic and diastolic blood pressure by either increasing or decreasing it [4]. This agrees with the findings of Maduagwu et al.[2], Uijen and Hassink-Franke [4], Moorthy et al[6], Panayiotou et al. [7] and Dewar et al [8]. It was also found that stages of stroke have significant effect on elevated IABPD which could also be attributed to muscle tonicity as stage of stroke also represents the tone of the muscle at a given period.

Limitations of the study

This preliminary study involved only 61 participants, thus the study result might not have captured enough to make incontrovertible conclusions. The study utilized literatures that seem to be later than 2 decades ago due to unavailability of studies.

Conclusion

Differences could exist in blood pressure measure when taken from both arms and it is deemed abnormal when it is greater than or equal to 10mmHg. It is important to observe this difference in the blood pressure measurement of patients with diseases like stroke which can reoccur especially during their initial assessment and as they are undergoing treatment. Special attention should be given to women as they are more likely to have this elevated IABPDs. It is recommended that BP should be taken from both arms as to be properly informed and to detect any elevated differences and to assist to optimally monitor and care for stroke patients.

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