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Research Article

Relationship between Arterial Stiffness and CHA_2DS_2-VASc Score in AF-related Stroke Patients

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Abstract

Aim: Arterial stiffness is related with both atrial fibrillation (AF) and stroke. The CHA_2DS_2-VASc score is used to assess stroke risk in patients with AF. In this study, it was aimed to examine the relationship between arterial stiffness and CHA_2DS_2-VASc score in AF-related stroke patients.

Material and Methods: Thirty stroke patients with paroxysmal AF participated in this research. Calculations of the patients' pre-stroke CHA_2DS_2-VASc scores were made. The SphygmoCor device was used to assess the Carotid-Femoral Pulse Wave Velocity (cfPWV), which served as a surrogate for arterial stiffness. It was determined whether or not there was a statistical connection between the CHA_2DS_2-VASc score and arterial stiffness.

Results: The patients were seperated into groups based on their CHA_2DS_2-VASc scores prior to the stroke (group 1: score=0-1, group 2: score=≥2). The two groups' characteristics were comparable, except for age, BMI and systolic blood pressure. Patients with high CHA_2DS_2-VASc scores (group 2) demonstrated significantly greater cfPWV values than those with low scores (group 1). The CHA_2DS_2-VASc score and the cfPWV revealed a favourable association in the correlation study.

Conclusion: The CHA_2DS_2-VASc score and cfPWV were substantially and linearly associated. Calculation of CHA_2DS_2-VASc and monitoring of arterial stiffness in stroke-prone individuals may be stimulus for taking preventive measures from stroke in these patients.

Keywords: CHA_2DS_2-VASc, atrial fibrillation, pulse wave velocity

INTRODUCTION

Arterial stiffness is defined as the limitation of the artery to expand or contract against pressure, depending on the stiffness of the arterial wall (1). It can emerge both physiologically (aging) and pathologically. The significance of arterial stiffness, which is regarded as a marker of vascular illnesses, in the emergence of cardiovascular (CV) disorders has been the focus of intense investigation recently. In patients with hypertension (HT), diabetes mellitus (DM), and end-stage renal disease, arterial stiffness has been shown to predict CV morbidity and mortality (2). In one study, it was shown that each standard deviation increases in carotid-femoral pulse wave velocity (cfPWV) raised the risk of CV events and death by 30% (3). The main diagnostic method for measuring arterial stiffness is cfPWV (2). It is recommended to use cfPWV 10 m/s as the cut-off value for the estimation of CV events (4).

Stroke is still a serious public health issue due to the morbidity and mortality it causes. Stroke risk is increased by artery stiffness (5). It's also associated with vascular events after stroke (6). In the studies of Gasecki and Kwarciany et al., it was shown that short and long-term follow- up outcomes in patients with ischemic stroke

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were worse in the group with high PWV (7, 8).

According to research, there is a link between arterial stiffness and atrial fibrillation (AF), which causes stroke (9). The CHA_2DS_2-VASc scoring system is used to assess stroke risk and initiate anticoagulation in individuals with AF (10). This scoring method can also be used to assess stroke risk in patients who do not have AF (11). However, to our knowledge, there is lack of data to compare arterial stiffness between high and low CHA_2DS_2-VASc score groups. This study's objective was to investigate the relationship between arterial stiffness and the CHA_2DS_2-VASc score in stroke patients who had paroxysmal AF.

MATERIAL AND METHOD

Study Population

Patients who had been hospitalized for a stroke were enrolled in the study (n=104). Patients having a history of cardiac surgery, chronic AF, acute coronary syndrome, uncontrolled HT (≥140/90 mmHg) at the time of cfPWV measurement, and moderate to severe valvular disease were excluded (n=74). The demographic features of the stroke patients including age, sex, history of heart failure, HT, DM, coronary or peripheral artery disease (PAD) noted and pre-stroke CHA_2DS_2-VASc scores calculated according to the guideline (10). Patients with low score (0-1) were assigned to group 1, while those with high scores (≥ 2) were assigned to group 2. Resting blood pressure (systolic and diastolic) measured from right upper arm and the mean of the two measurements recorded. The kg/m^2 formula and the patients' recorded weights (kg) and heights (meters) were used to compute the BMI. This study received permission from the regional ethical committee (approval date/number: 07.11.2016/3). The rights of all participants were protected, and written informed consents were obtained prior to the procedures.

Echocardiographic evaluation

Echocardiographic evaluation was made with 2-D GE Vivid 7 ultrasound device (Horten, Norway) via transthoracic. Diameters, mass index and ejection fraction (used Simpson's method) of left ventricle (LV) and left atrium diameters were measured.

Arterial Stiffness Measurement

The cfPWV results measured with the SphygmoCor system were utilized to assess arterial stiffness. Patients were advised not to smoke or to consume caffeine-containing drinks or alcohol 12 hours before the assessment. After 10 to 15 minutes of supine resting, the patient's cfPWV was ascertained by successively recording the waveforms of arterial pressure across the femoral and carotid arteries using a micromanometer probe placed on the skin at the location of peak arterial pulsation. After 10 to 15 minutes of supine resting, the patient's cfPWV was ascertained by successively recording the waveforms of arterial pressure across the femoral and carotid arteries using a micromanometer probe placed on the surface at the location of peak artery pulse. Simultaneous electrocardiogram (ECG) was used to obtain the cfPWV measurements. The distances among the carotid and femoral sampling places to suprasternal notch were measured using an elastic tape measure (2). The cfPWV was calculated as the average of at three consecutive beats obtained over 10 seconds. Furthermore, the presence of cfPWV at speeds greater than 10 m/s has been linked to target organ damage (12). As a result, in both groups, we assessed the presence of cfPWV > 10 m / s as an indicator of target organ damage.

Statistical Analysis

Categorical variables were presented as numbers and percentages, while continuous variables were shown as a mean ± standard deviation. The distribution patterns of the continuous variables were analyzed by histogram and Kolmogorov-Smirnov test. While Mann-Whitney U test was used to evaluate continuous variables without normal distribution, independent t-test was utilized to analyze normally distributed variables. Using the chi-square test, categorical variables were assessed. Finally, the relationship between continuous variables was determined using Pearson correlation analysis. Statistical significance was defined as a two-sided p-value <0.05. SPSS (v.13.0) was utilized for statistics (SPSS Inc., Chicago, IL, USA).

RESULTS

Table 1. The study population's baseline characteristics

	Group 1 (CHA_2DS_2-VASc 0-1 [n = 10])	Group 2 (CHA_2DS_2-VASc ≥2 [n = 20])	p-value
Age (years)	51.9±10.5	73.1±5.8	0.001
Age 65-74, n, (%)	0	11 (55%)	0.004
Age >75, n, (%)	0	9 (45%)	0.013
Gender			
Female, n, (%)	3 (30%)	13 (65%)	0.122
HF n, (%)[a]	0	1 (5%)	1.0
HT n, (%)	6 (60%)	17 (85%)	0.18
DM n, (%)	0	5 (25%)	0.14
Blood pressure (mmHg)			
Systolic	117.5±10.9	127.5±11.6	0.03
Diastolic	75±5.3	76±9.9	0.72
BMI	25.2±2.5	28.7±5	0.04
Left ventricle			
ESD (mm)	29.7±6.3	28.6±5.5	0.58
EDD (mm)	48±6.1	44.7±5.1	0.09
Mass index	102.1±27	111.6±21	0.15
EF (%)	62.5±4.2	61.3±8.3	0.87
LA diameter (mm)	36.4±4.7	37.3±3.7	0.30
CF-PWV (m/s)	8.95±1.72	11.8±2.5	0.003
CF-PWV >10 (m/s)	2 (20%)	14 (70%)	0.02

BMI: body mass index, CF-PWV: carotid-femoral pulse wave velocity, DM: diabetes mellitus, EDD: end-diastolic diameter, EF: ejection fraction, ESD: end-systolic diameter, HF: Heart failure, HT: hypertension, LA: left atrium, LV; left ventricle (Values were presented as numbers (%), mean SD, or medians (inter quartile range, IQR)

Thirty patients hospitalized for stroke (Total 104 patients included between December 2016 and May 2017; according to exclusion criteria 74 patients were excluded) without exclusion criteria were participated in the study. The distribution of men and women was comparable (53% female). Group 1 (CHA_2DS_2-VASc 0-1) consisted of ten patients, while group 2 (CHA_2DS_2-VASc ≥2) consisted of twenty.

Table 1 shows the baseline demographic features, and those were similar in both groups except for age, BMI and systolic blood pressure. The age, BMI and systolic blood pressure was higher in group 2. Similar echocardiographic measurements were found in both groups, however group 2's cfPWV was greater (8.95±1.72 vs. 11.8±2.5; p=0.03, respectively). Additionally, patients in group 2 had greater aortic target organ damage than group 1 as measured by the presence of cfPWV > 10 m/s.

The CHA_2DS_2-VASc score and the cfPWV significantly correlated in Pearson correlation analysis (r=0.562, p=0.001).

DISCUSSION

We investigated the link between arterial stiffness and the CHA_2DS_2-VASc score in stroke patients with non-valvular AF in this study. The key findings were as follows: first, subjects with a high CHA_2DS_2-VASc score (group 2) had higher cfPWV than those with a low score (group 1); second, cfPWV was substantially associated to CHA_2DS_2-VASc score; and third, aortic target organ damage was higher in group 2.

Previous research has found that stroke patients have higher arterial stiffness and arterial stiffness can significantly predict stroke (5). The main determinants of PWV are age, blood pressure, diabetes status and race, while smoking, lipid levels and gender do not significantly affect PWV (9,13). In our study, age and blood pressure values were higher in the group 2, and cfPWV was also higher. This could be because the characteristics affecting stroke and arterial stiffness are also common parameters that determine a high CHA_2DS_2-VASc score. The group with high CHA_2DS_2-VAScscore also had a higher percentage of patients with a cfPWV of >10 m/sec. This shows that this group has a higher predicted risk of CV events.

According to study by Kowalczyk et al., the course of PWV after stroke changes over time and is higher in the acute stroke period (14). Kwarciany et al., demonstrated that hypertensive response in stroke is linked with increased arterial stiffness (15). Antihypertensive drugs reduce blood pressure and arterial stiffness. Since blood pressure is increased in some of the stroke patients (5), a decrease in arterial stiffness values can be achieved with antihypertensive treatment to be used in these patients. CHA_2DS_2-VASc calculation and arterial stiffness monitoring in stroke-prone individuals may serve as a catalyst for these patients to take stroke prevention strategies. In our study, stroke patients did not have long-term arterial stiffness measurements, so we do not know how arterial stiffness progresses in stroke patients with different CHA_2DS_2-VASc scores.

AF-related stroke accounts for 30% of all ischemic strokes (10). Various studies have found a connection among arterial stiffness and AF. Arterial stiffness has been shown to have adverse effects on both atrial diameters and strain (9). These factors are also predictive factors for AF and therefore stroke. Chen et al discovered that cfPWV was elevated in patients younger than 60 years of age with isolated AF who had no additional risk factors for AF. Changes in vascular structure, both structural and functional, may have a role in the etiology of AF (16). In a recent investigation, Chung et al. discovered that in people with intermediate or high CV risk, increased arterial stiffness significantly predicts the development of AF (17). All participants in our study were patients with AF-related stroke. However, patients with low CHA_2DS_2-VASc scores had low arterial stiffness measurements. This might be explained by the relative small number of patients in this group overall.

Our study had some limitations; it was a single-center study and arterial stiffness was measured in patients who had a recent stroke. This was not a follow-up study, so long-term follow-up data on arterial stiffness and CHA_2DS_2-VASc score findings and clinical outcomes were not available. Also, there may be errors in measurements and calculations made by the SphygmoCor device. For example, minor errors in measuring the distance among the the carotid and femoral sites can result in significant calculation errors, especially in people with a large chest and abdominal obesity. In addition, noisy ECG recordings and failure to obtain stable waveform recordings may lead to miscalculations. All arterial stiffness measurements were meticulously performed to prevent these possible mistakes and only high-quality recordings with a quality index of more than 80% were included. The association between arterial stiffness and CHA_2DS_2-VASc in patients with the same CHA_2DS_2-VASc score, who have similar age and blood pressure, can be demonstrated more accurately, but prospective, multicenter studies are needed for this.

CONCLUSION

There are common parameters between the constituents of the CHA_2DS_2-VASc score and the determinants of arterial stiffness. Both AF and stroke are possible outcomes of arterial stiffness. The adoption of arterial stiffness as a target value in stroke-prone patients has the potential to prevent a sizable population from stroke. Measurement of arterial stiffness in addition to the CHA_2DS_2-VASc score may contribute to a more accurate stroke risk assessment. We need further studies on this topic.

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