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Is there a correlation between dizziness and intracranial artery calcification?

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SUMMARY

OBJECTIVE: This study aimed to investigate the correlation between dizziness and intracranial artery calcification.

METHODS: A total of 107 consecutive patients were recruited for this study. These patients were categorized into first (case) and second (control) groups. The first and second groups had complaints of dizziness and headache, respectively. All the patients had noncontrast cranial computed tomography images. Bilateral internal carotid arteries, bilateral vertebral arteries, and basilar arteries were evaluated for detecting burden of intracranial artery calcification. Finally, demographic characteristics, stroke risk factors, and burden of intracranial artery calcification of these two groups were compared. The Mann-Whitney U test, chi-square test, and Spearman's correlation were performed to analyze the study.

RESULTS: It was found that the first and second groups included 39 and 68 patients, respectively. The mean age of the first group was significantly higher than that of the second group. The mean burden of intracranial artery calcification of the posterior circulation in the first and second groups were not statistically different from each other (p=0.555). The mean burden of intracranial artery calcification of the anterior circulation in the first group was found to be significantly higher than the second group (p=0.005). However, no significant difference was found between the two groups in terms of burden of intracranial artery calcification of anterior or posterior circulation, when the age variable was synchronized in both groups.

CONCLUSION: Although this study found a limited correlation between dizziness and intracranial artery calcification, this situation was basically related to aging.

KEYWORDS: Carotid arteries. Tomography. Ischemia. Cerebrovascular circulation. Vascular diseases.

INTRODUCTION

Dizziness is a nonspecific term that refers to a sense of disorientation without a false sense of motion. It varies from vertigo to a general feeling of instability and generally affects elderly people[1-5]. Etiologies of dizziness include metabolic, cardiovascular, neurologic, and psychiatric diseases. However, no objective evidence of the etiology is found. Nevertheless, vascular causes should not be neglected, as they can be mortal[3-5]. Therefore, a decrease in blood perfusion of the anterior or posterior circulation due to stenosis or occlusion may cause the symptom of dizziness[1,2,5,6]; however, some authors find no evidence to support this pathophysiology[2].

Dizziness is a common complaint in outpatient clinics and is found in approximately 5% of patients as a primary symptom. Previous studies have suggested that many of these patients have abnormalities in the vertebrobasilar and carotid arteries associated with dizziness, especially in the elderly patients[5,7,8]. However, dizziness with vascular etiology seldom requires surgical treatment[7].

Intracranial artery calcification (IAC) is a noninvasive imaging marker that is incidentally detected on brain computed tomography (CT), especially in advanced age[9-11]. The author supposes that arterial calcification (AC) is caused by the accumulation of calcium-phosphate complexes in the vessels.

Some studies claim that AC is a part of the active process of atherosclerosis and may be affected by aging, diabetes mellitus, and chronic kidney disease[9,11-14]. AC may occur in up to 90% of atherosclerotic lesions in vessels[13]. Therefore, it can be hypothesized that IAC may be a potential predictor of future ischemic stroke[15,16]. Moreover, IAC may be associated with transient ischemic attacks, epileptic seizures, and cognitive decline[11,14]. However, a relationship between IAC and dizziness has not yet been reported in the literature. Hence, this study aimed to investigate whether or not there is a correlation between ICA and dizziness.

METHODS

Patients

A total of 107 consecutive patients (53 males and 54 females) with complaints of dizziness (first group) or headache (second group) and noncontrast cranial CT images were recruited for this study. The first group was determined the main (or the

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case) group, and the second group was accepted as the control group. The patients who had no or insufficient CT images were not included in this study. The data of these two groups, which were gathered during 2-year periods from our hospital automation system, were analyzed. This study was performed retrospectively, and animals or human subjects were not included. Therefore, informed consent was not required.

Measurement of intracranial arterial calcification

Hyperdense lesions over 130 Hounsfield units observed on the noncontrast cranial CT images were assumed to be intracranial arterial calcification (IAC). Bilateral internal carotid arteries (ICAs), bilateral vertebral arteries (VAs), and basilar arteries (BAs) were evaluated. Of the patients with circular calcification on the intracranial arterial walls in the axial section on the noncontrast cranial CT, those with calcification below 50% of the arterial diameter were given one point, and those with 50% or above were given two points (Figure 1). Those without calcifications were given zero points. For each patient, the burden of IAC (BIAC) of anterior (bilateral ICAs) or posterior (bilateral VAs and BAs) circulation was calculated by summing all these points.

Statistical analysis

The IBM Statistical Package for the Social Sciences (SPSS) 26.0 (SPSS Inc., Chicago, IL, USA) program was used for evaluating data. Demographic characteristics, stroke risk factors (hypertension, diabetes mellitus, hyperlipidemia, coronary artery disease [CAD], chronic kidney disease, atrial fibrillation, smoking, and stroke history), and BIAC of these two groups were compared. The Mann-Whitney U test was used for continuous variables, the chi-square test for categorical variables, and Spearman's rho test for correlation. A p-value of <0.05 was considered statistically significant in all analyses.

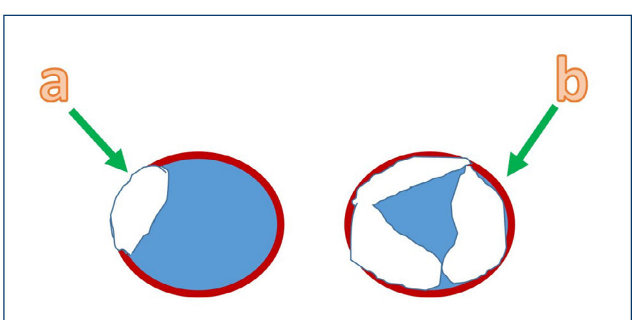

Figure 1. Calcifications observed in intracranial arteries (green arrow). (a) Calcifications that narrow the diameter of intracranial artery below 50%. (b) Calcifications that narrow the diameter of intracranial artery above 50%.

RESULTS

In this study, 39 and 68 patients were consecutively included in the first and second groups, respectively. The sex distribution of these two groups was found to be close to each other (chi-square test; p=0.784). However, the mean age of both groups was found to be significantly different from each other (Mann-Whitney U test; p<0.001). There was no significant difference between these two groups in terms of stroke risk factors (chi-square test; p>0.05), except for CAD (chi-square test; p<0.001). The comparison of the two groups in terms of gender, age, and stroke risk factors is summarized in Table 1.

In this study, calcifications were detected in the posterior circulation in 23 VAs on the right and 26 VAs on the left, along with 3 BAs. However, calcifications were observed in the anterior circulation in 58 and 54 ICAs on the right and left sides, respectively. The mean BIAC of the posterior circulation was found 0.76±1.31, and the mean BIAC of the anterior circulation was calculated 1.78±1.79. The mean BIAC of the posterior circulation of the first and second groups were similar (Mann-Whitney U test; p=0.555); however, the mean BIAC of the anterior circulation of the first group was significantly higher than that of the second group (Mann-Whitney U test; p=0.005). In addition, a strong positive correlation was found between age and the BIAC of the anterior or posterior circulation (p<0.001). Table 2 shows the comparison of the two groups according to BIAC and the correlation of age with BIAC. To dismiss the effect of the age variable, only patients over 40 years old were included in the first and second groups (n=35 vs. n=39, respectively). Then, the analysis was repeated regarding the new sample size. However, no significant difference was

Table 1. Comparison of the two groups in terms of sex, age, and stroke risk factors.

Variables	First group	Second group	p-value
Age (years)	64.72±15.13	48.68±19.79	**<0.001**
Sex (m/f)	20/19	33/35	0.784
DM (%)	25.6%	19.1%	0.429
HTN (%)	51.3%	33.8%	0.076
CAD (%)	41%	10.3%	**<0.001**
AF (%)	7.7%	2.9%	0.352
Stroke (%)	25.6%	11.8%	0.065
CKD (%)	15.4%	11.8%	0.593
HL (%)	12.8%	14.7%	0.787
Smoking (%)	12.8%	2.9%	0.097

DM: diabetes mellitus; m: male; f: female; HTN: hypertension; CAD: coronary artery disease; AF: atrial fibrillation; CKD: chronic kidney disease; HL: hyperlipidemia. Bold indicates statistically significant p-values.

Table 2. Comparison of the two groups according to burden of intra-arterial calcification and correlation of age with burden of intra-arterial calcification.

	First group	Second group	p-value	Age (Spearman correlation)	p-value
Anterior BIAC	2.41±1.74	1.41±1.73	**0.005**	rho=0.746	**<0.001**
Posterior BIAC	0.82±1.33	0.73±1.30	0.555	rho=0.622	**<0.001**

BIAC: burden of intra-arterial calcification; rho: correlation coefficient. Bold indicates statistically significant p-values.

found between the two groups in terms of BIAC of the anterior or posterior circulation (Mann-Whitney U test; p=0.674 vs. p=0.221, respectively).

DISCUSSION

In this study, intra-arterial calcifications were detected in a total of 112 arteries in the anterior circulation and 52 arteries in the posterior circulation. It was observed that the anterior total BIAC was higher than that in the posterior circulation. Moreover, the mean anterior BIAC was found to be significantly higher in the first group than that in the second group, statistically. However, it was found that this significant difference disappeared when the age variable was equalized in both groups. Previous studies reported that male patients were more associated with IAC than female ones[11,13]. Our study showed that there was no significant sex difference between the two groups.

Arterial calcification is a vascular lesion that mainly affects the intima or media layers of the vessel wall and is generally changed by aging and common cardiovascular risk factors[11]. Consistent with the literature, our study revealed a strong positive correlation between age and the BIAC. However, there was a significant difference between these two groups according to only CAD. AC can be found in various vessels and causes different hemodynamic changes or outcomes. An unenhanced CT is thought to be the best tool for detecting calcifications[13]. A density ≥130 HU on CT imaging is generally accepted as a diagnostic criterion for calcification[9,10].

Several studies have demonstrated that the intracranial carotid artery and VA are the most affected vessels, respectively[9,10,13,17]. Therefore, some authors claim that AC, specifically heavier calcifications, may increase the risk of stroke by changing arterial flow and enhancing arterial stiffness[9-11,13,14,18]. They also claim that IAC may be accepted as an indicator of atherosclerosis[13]. However, the pathophysiological relationship between calcification and ischemia is still controversial[12,14,17]. Furthermore, some researchers assume that calcified plaque is less related to ischemic symptoms than noncalcified plaque in preventing plaque rupture. They have also observed that patients with intimal IAC tend to have good collateral circulations before endovascular treatment[19].

Previous reports show that calcifications are found mainly in the cavernous or siphon segments of ICAs and the intracranial segment of VAs. Hence, our study focuses on these parts of vessels to calculate BIAC clearly. Some studies have also shown that calcifications are found more frequently in the left VA than in the right side[17]. In this study, there were no significant differences between both sides. In the literature, various methods have emerged to calculate the severity of calcification[13]. However, different methods may preclude the comparison of findings from various studies. Therefore, the present study used a new simple visual grading method related to the narrowing of the vessel lumen by calcification.

Dizziness is a common symptom in outpatient clinics and accounts for over half of vestibular system diseases[4,8]. Within cerebrovascular diseases, severe carotid artery stenosis (CAS) may be one of the significant nonvestibular causes of dizziness. However, the relationship between CAS and dizziness is not clearly understood, and some conflicts between studies are still emerging. On the one hand, some authors claim that severe CAS can decrease perfusion through the carotid circulation; on the other hand, others accept dizziness as an asymptomatic symptom, although there is an occluded carotid artery[2,5,7,8,20]. In the literature, although there are a lot of reports about the relationship between CAS and dizziness, there have been no studies about the relationship between calcification and dizziness.

Our study has some limitations. First, the study is designed retrospectively. Second, the flow rate and volume of vessels (ICAs and VAs), which may be disturbed by the calcifications, are not included in the study. Finally, a new visual grading method, whose validity has not yet been proven, is used to calculate the severity of AC.

CONCLUSION

This study found that the group with dizziness had much more calcifications than the control group. However, we found that dizziness was not associated primarily with IAC when the age variable was equalized in both groups. To the best of our knowledge, both dizziness and IAC are usually seen in old patients. Therefore, they can occur coincidentally with aging. As a result, prospective studies with a large sample size are needed in the future to investigate the relationship between IAC and dizziness comprehensively.

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