

The correlation between the mouth diameter of left atrial appendage and stroke risk score in patients with atrial fibrillation

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Abstract. – OBJECTIVE: Our objective is to explore the correlation between the mouth diameter of left atrial appendage (LAA) and stroke risk score in patients with atrial fibrillation (AF), to find the effective ways to improve diagnosis and treatment level.

PATIENTS AND METHODS: 112 patients with AF during January 2011-April 2013 were retrospectively analyzed, including 79 cases with paroxysmal AF and 32 cases with persistent AF or long-standing persistent AF (LS-AF). Radiofrequency catheter ablation (RFCA) and transesophageal echocardiography were used to detect the maximum mouth diameter of LAA, the correlation of which with stroke risk score was analyzed.

RESULTS: In the patients with paroxysmal AF, the mouth diameter of LAA was 18.63 ± 4.14 mm, CHADS2 score was 0.91 ± 0.90 points and CHA2DS2-VASc score was 1.89 ± 1.36 points while in the patients with persistent AF or LS-AF, the mouth diameter of LAA was 20.68 ± 5.49 mm, CHADS2 score was 0.85 ± 0.84 points and CHA2DS2-VASc score was 1.67 ± 1.41 points. The mouth diameters of LAA, CHADS2 score and CHA2DS2-VASc score were statistically different between these two types of AF ($p < 0.05$). Moreover, the mouth diameter of LAA, CHADS2 score and CHA2DS2-VASc were not statistically correlated with paroxysmal AF or persistent AF ($p > 0.05$).

CONCLUSIONS: Different types of AF are correlated with the mouth diameter of LAA, however, the mouth diameter of LAA is not correlated with stroke risk score.

Key Words:

Mouth diameter, Left atrial appendage, Atrial fibrillation, CHADS2 score, CHA2DS2-VASc score, Correlation.

patients with AF⁴⁻⁷. The researches have shown that the effects of stroke risk factors such as hypertension, coronary heart disease and heart failure on AF decrease as the age increases; however the effect of AF on stroke is higher and higher⁸⁻¹⁰. Especially in patients aged more than 80 years, AF is the only risk factor¹¹⁻¹³. In this study, we explored the correlation between the mouth diameter of LAA (LAA) and stroke risk score in patients with AF in order to provide a better evidence base for clinical treatment.

Patients and Methods

Patients

112 patients with AF during January 2011-April 2013 were retrospectively analyzed, including 82 male cases and 40 female cases. The average age of the patients was 68.1 ± 3.4 years range from 49-77 years. 79 cases had paroxysmal AF and 32 had persistent AF or LS-AF. The present and past medical history of all included patients was carefully investigated, and physical examination and conventional ultrasonic cardiogram were applied. The organic heart disease was excluded, and the paroxysmal or persistent AF was diagnosed by 12-lead electrocardiogram and 24-hour dynamic electrocardiography. The diagnostic criteria are that p wave disappears in ECG, and f wave appears with irregular morphology, amplitude and interval with a frequency of 350-600/min. The patients who aged less than 18 years, refused to accept transesophageal echocardiography, did not sign an informed consent, or had contraindications such as hemorrhagic disease and esophageal stenosis were excluded¹⁴.

Collection of Clinical Data

The general clinical data of patients were collected, including age, gender, type of AF, smok-

Introduction

AF is a common arrhythmia clinically. In the recent years, the overall morbidity of AF is 0.7%, which is increased year by year¹⁻³. The risk of thromboembolism complications, especially stroke, has been the biggest harm to the

ing history, cardiovascular and cerebrovascular diseases, heart rate and blood pressure. The medical history such as hypertension, diabetes mellitus and hyperlipidemia, and drug administration history including anticoagulant drug, lipid-lowering drug and antihypertensive drug were also collected.

Patients and Methods

Sequoia Doppler ultrasonic diagnosis apparatus with a frequency of 5.0-8 MHz (Simens AG) was used in this study. The apparatus has multiple functions including M-mode ultrasound, two-dimensional ultrasound and Doppler ultrasound. By pressing the buttons on operating handle, the transducer chip on multiple-plane transesophageal ultrasonic probe can rotate from 0-180 to obtain 360 degrees of the heart section images.

The patients had fastened for 4-6 hours before receiving anesthesia by 2% lidocaine gel at oropharynx. They were asked to take a left lateral position, unfasten their collars and ties, and then the 12-lead ECGs were examined. The probe was smeared with couplant and then placed into the mouth of the patient, and when the probe reached oropharynx the patient was asked to do swallowing action. Then the probe was inserted to esophagus and then gastric fundus along with the action; after that, the probe was gradually withdrawn until the locus medialis which was 30 cm from incisor. The horizontal section of left heart, four-chamber view section and LAA section were scanned. The probe was rotated from 0-180 degrees to detect the internal structure and echo of left atrium and LAA maximally. The patients were evaluated by CHADS₂ scoring and CHA₂DS₂-VASc scoring according to the above data, and the criteria are shown in Table I.

Statistical Analysis

SPSS16.0 (SPSS Inc., Chicago, IL, USA) was used to analyze the data. The measurement data were analyzed by *t* test. $p < 0.05$ was considered as statistically significant.

Results

Comparison of Mouth Diameters of LAA in Different AF types

A comparison was made between patients with paroxysmal AF and those with persistent or LS-AF. As shown in Table II, the mouth diameter of LAA, CHADS₂ score and CHA₂DS₂-VASc score were statistically different between these two types of AF ($p < 0.05$). Compared with those in the patients with persistent AF or LS-AF, the mouth diameter of LAA was significantly smaller, but both the CHADS₂ and CHA₂DS₂-VASc scores were significantly higher in the patients with paroxysmal AF.

The Correlations Between the Mouth Diameter of LAA, CHADS₂ score, CHA₂DS₂-VASc Score and Different AF Types

The correlations between mouth diameter of LAA, CHADS₂ score, CHA₂DS₂-VASc score and different AF types were calculated. As shown in Table III, the mouth diameter of LAA, CHADS₂ score and CHA₂DS₂-VASc were not statistically correlated with paroxysmal AF ($p > 0.05$). Similarly, as shown in Table IV, the above-mentioned three parameters were also not correlated with persistent AF ($p > 0.05$).

Discussion

The LAA is the residue of left atrium primitive germ formed in the 3rd week of gestation, which

Table I. Criteria of CHADS₂ score and CHA₂DS₂-VASc score (point).

Risk factor	CHADS ₂ score	CHA ₂ DS ₂ -VASc score
Congestive heart failure/left ventricular dysfunction	1	1
Hypertension	1	1
Age ≥ 75 years	1	2
Diabetes mellitus	1	1
Brain stroke/transient ischemic attack (TIA)/thromboembolism	2	2
Vascular disease		1
Age 65-74 years		1
Female		1

Table II. Comparison of mouth diameter of LAA in different AF types ($\bar{x} \pm s$).

Item	Paroxysmal AF	Persistent or LS-AF	<i>t</i> value	<i>p</i> value
Mouth diameter of LAA (mm)	18.63 $\pm$ 4.14	20.68 $\pm$ 5.49	7.5786	< 0.05
CHADS2 score (point)	0.91 $\pm$ 0.90	0.85 $\pm$ 0.84	6.4674	< 0.05
CHA2DS2-VASc score (point)	1.89 $\pm$ 1.36	1.67 $\pm$ 1.41	9.6833	< 0.05

Table III. The analysis of paroxysmal AF related factors.

Variate	β	SE	Wald value	<i>p</i> value	OR	95% CI
Mouth diameter of LAA (mm)	2.581	3.807	5.683	0.567	4.369	1.214-13.249
CHADS2 score	3.185	4.147	6.579	0.468	5.247	1.367-12.578
CHA2DS2-VASc score	3.069	4.073	6.257	0.863	4.588	1.258-13.216

Table IV. The analysis of persistent AF related factors.

Variate	β	SE	Wald value	<i>p</i> value	OR	95% CI
Mouth diameter of LAA (mm)	2.605	3.137	3.578	0.178	4.625	1.074-10.256
CHADS2 score	2.780	2.694	3.683	0.773	5.268	1.247-11.237
CHA2DS2-VASc score	3.025	2.137	3.136	0.898	4.244	1.057-10.349

is the prolonged protrusion of atrium protruded to right and anterior side, and is a narrow, long and curved tube¹⁵. The long and short diameter of normal LAA mouth are 18 mm and 10 mm, and its depth is around 20 mm. The shortest distance from the LAA mouth to upper and lower left pulmonary vein orifice, and mitral valve were around 5 mm and 8 mm. There are many deep incisura at the margin of LAA to make it lobular, and abundant pectinate muscles and trabeculars to make it bumpy, all of which make it liable to form thrombosis^{16,17}. It has been reported that the LAA in patients with LAA atrial fibrillation is mostly tubular and univalent while in atrial septal defect patients, it is mostly quasi-circular or irregular, diphyllous or polyphyllous¹⁸. Compared with right atrial appendage, LAA has deeper jagged incisura at its margin, and its volume is also bigger¹⁹.

Reports^{16,20} have shown that the involvement of mouth diameter of LAA in the mechanism of thrombogenesis is as following: (1) Hemodynamic abnormalities in AF; (2) Loss of rhythmic contraction of atrium, which cause a decrease in the blood flow speed in left atrium at diastole; 3) The long-term congestion can cause thrombogenesis²¹⁻²³. LAA resembles a caecum cavity, and AF can enlarge LAA. The special

tubular structure of LAA and the trabecular structure of endocardium can cause blood congestion. The factors such as hypertension and age cause the injury or fibrosis of endocardium in LAA, which may be involved in thrombogenesis²⁴. It is reported²⁵ that enlargement and mechanical dysfunction of left atrium lead to blood congestion and therefore promoting thrombogenesis in LAA, which increase the risk of thrombogenesis. The risk factors in CHADS2 scoring including heart failure, hypertension and diabetes are considered to be related to left atrial remodeling, and studies have proven that enlargement of left atrium is related to potential cardiogenic embolism^{26,27}. Clinically, different cytokines can lead to dysfunction of endothelial cells, including carbonic oxide, angiotensin-converting enzyme 2 (ACE2) and its receptor, plasminogen, endothelin and so on, which blocks myocardial electrical coupling to cause atrium enlargement and thrombogenesis²⁸.

CHADS2 scoring includes several items such as congestive heart failure, hypertension, diabetes, age and past stroke history. CHA2DS2-VASc scoring further refines CHADS2 scoring, in which vascular disease, female, age of 64-75 years, past thromboembolism are added.

Our results showed that the mouth diameter of LAA is larger, but both CHADS2 score and CHACHA2DS2-VASc score were lower in the patients with persistent AF or LS-AF than those in the patients with paroxysmal AF, which confirmed the conclusion in previous studies^{29,30}. The results indicate that persistent AF can cause atrium to lose systolic and diastolic function, cause irregular ventricular rate, increase the pressure of left atrium, and progressively enlarge the left ventricle. The LAA is gradually enlarged due to the traction by left atrium and subsequent compensatory regulation, and then the systolic function is decreased and the blood in left atrium cannot be effectively evacuated, which causes congestion and thrombogenesis. The results are helpful for the diagnosis and treatment of patients with AF. Clinically, ultrasound cardiogram is usually used as supplementary examination to confirm the diagnosis, and anticoagulation drugs such as aspirin are administered for prevention.

Our results also showed that the mouth diameter of LAA in paroxysmal AF and persistent AF or LS-AF were not correlated with CHADS2 score and CHACHA2DS2-VASc score, which are in accordance with previous reports. It is considered that the scoring is subjective, and the mouth diameter of LAA is affected by systolic function of left ventricle and diameter of pulmonary artery. The disadvantages of our study are that the related laboratory examinations were not applied to confirm the condition of stroke and the severity of AF was not evaluated.

In contrary to our results, several studies have shown that mouth diameter of LAA in persistent AF is related to CHADS2 score and CHACHA2DS2-VASc score, especially in the aged patients with hypertension, which may be due to that hypertension is the risk factor of stroke³¹. Since most of experiments have been done in animals, and the objective clinical evidence is insufficient, further clinical observation is needed.

Conclusions

Our results demonstrate that different types of AF are correlated with the mouth diameter of LAA; however, the mouth diameter of LAA is not correlated with stroke risk score in patients with AF.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

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