Left Atrial Volume Index Predicts Recurrence of Stroke in Patients with Nonsustained Atrial Tachycardia

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Background: Nonsustained atrial tachycardia (NSAT) is known to appear more frequently in patients with paroxysmal atrial fibrillation (AF). Enlarged left atrium (LA) is considered to be an independent risk factor for newly diagnosed AF. *Methods:* We investigated the risk factors for predicting the stroke recurrence in NSAT patients. In total, 252 patients (114 women, mean 70 ± 11 years) with acute ischemic stroke and documented NSAT in 24-hour Holter monitoring were enrolled and followed. All patients underwent echo–Doppler evaluations. *Results:* During a mean follow-up period of 35 ± 31 months, the stroke recurrence rate was 11.1% (28 of 252). The patients with recurrence (n = 28) had higher left atrium volume index (LAVI, $P < .001$) and higher E/e′ ($P = .028$) compared with those without recurrence (n = 224). On the Kaplan–Meier survival analysis, stroke recurrence rate was significantly higher in patients with enlarged LA (LAVI >28 mm3/m2; $P < .001$ by the log-rank test), and it remained significant in multivariate analysis (hazard ratio, 1.154; 95% confidence interval [CI], 1.099-1.212, $P < .001$). *Conclusions:* In patients with acute ischemic stroke and NSAT, enlarged LA predicts an increased risk of stroke recurrence. This study supports the necessity of prolonged rhythm monitoring in stroke patients with NSAT and enlarged LA to detect undiagnosed AF and consequently considering anticoagulation therapy. **Key Words:** Atrial tachycardia—stroke—recurrence—left atrial volume index.

Introduction

Approximately 20% of ischemic strokes are attributed to a cardioembolic source. Atrial fibrillation (AF) is the major cause of cardioembolic stroke,[1] and more than 75,000 cases of ischemic stroke in the United States are caused by AF each year.[2] Current guidelines recommend the use of anticoagulation in stroke patients with AF for secondary prevention of stroke.[2] Therefore, identifying AF is crucial because anticoagulation significantly reduces the risk of stroke recurrence.[3] However, current diagnostic strategies such as 24-hour electrocardiographic (ECG) monitoring lack sensitivity and often fail to detect newly diagnosed AF.[4,5] Furthermore, the usefulness of anticoagulation in stroke patients without documented AF is a controversial topic. Several studies have indicated the use of prolonged, continuous ECG monitoring for the detection of previously underdiagnosed AF in stroke

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patients. These studies may help improve clinical outcomes because more aggressive anticoagulation therapy would then be supported.[6-8] The American Heart Association/American Stroke Association guideline for the secondary prevention stroke recommends prolonged ECG monitoring for ischemic stroke or transient ischemic attack (TIA) patients with no other apparent cause.[2]

Some studies showed that enlarged left atrium (LA) is an independent risk factor for newly diagnosed AF.[9,10] Nonsustained atrial tachycardia (NSAT) is known to appear more frequently in patients with paroxysmal AF, and recent studies have demonstrated the association between frequent atrial premature beat (APB) or supraventricular tachycardia and increased risk of AF.[11-14] We hypothesized that those patients who presented with NSAT and enlarged LA would have a higher incidence of stroke recurrence resulting from previously undiagnosed AF. We investigated the risk factors that may predict poor outcomes in stroke patients where 24-hour Holter monitoring documented NSAT without paroxysmal AF.

Methods

Study Population

We enrolled 252 consecutive patients from January 2009 to December 2012 in the Severance or Gangnam Severance Hospital, Yonsei University College of Medicine, who had received a diagnosis of acute ischemic stroke and also showed NSAT in a 24-hour Holter monitoring. We reviewed brain magnetic resonance imaging (MRI) to exclude the atherosclerotic type and remain the cardioembolic type. Transesophageal echocardiography (TEE) was performed to evaluate the presence of intracardiac thrombi. We analyzed 1892 patients who had received a diagnosis of acute ischemic stroke without evidence of intracardiac thrombi, performed 24-hour Holter monitoring, and selected 252 patients who had showed NSAT among them. Inclusion criteria were as follows: (1) first diagnosis of acute ischemic stroke and patients hospitalized within 7 days after onset; (2) documented NSAT in a 24-hour ECG monitoring performed at that time of diagnosis of stroke; and (3) no history of AF. We performed transthoracic echocardiography, TEE, and 24-hour Holter monitoring in all patients within 7 days from the admission. NSAT was defined as 3 or more consecutive APBs with a rate more than 100 beats/min and lasting less than 30 seconds. APB was defined by the following criteria: (1) a reduced RR interval of 25% or more, (2) the presence of a P wave, and (3) a QRS width of less than .12 seconds. The diagnosis of stroke was based on neurologic examination by computed tomography or MRI or both, according to the *International Classification of Disease, Ninth Revision*. Exclusion criteria were (1) history of stroke or TIA; (2) known tachyarrhythmia, either supraventricular tachyarrhythmia, such as AF, or ventricular tachyarrhythmia; (3) atheroma on descending aorta or arch and carotid artery; (4) structural heart disease, such as valvular heart disease, or abnormal intracardiac shunt; (5) presence of cardiac pacemaker; (6) previous coronary artery disease, brain hemorrhage, brain tumor, and cerebrovascular malformation; (7) uncontrolled hypertension; (8) a left ventricular (LV) ejection fraction (EF) less than 50%; (9) neoplastic diseases; and (10) metabolic diseases. The patients were initially divided into 2 groups: group 1, those without stroke recurrence (n = 224) and group 2, those with stroke recurrence (n = 28). Electronic medical records were reviewed, and pertinent data points were recorded. The study protocol was approved by the Institutional Review Board of the Severance Cardiovascular Hospital, Seoul, Korea, and complied with the Declaration of Helsinki, and written informed consents were obtained.

Echocardiographic Study

Comprehensive echo–Doppler evaluation was performed according to the current American Society of Echocardiography guidelines.[15] Peak early (E) and late (A) diastolic mitral inflow velocities were measured in apical 4-chamber view. Tissue Doppler interrogation was done in septal mitral annulus in apical 4-chamber view, then peak systolic mitral annulus velocity and early diastolic mitral annulus peak velocity (e′) were measured, and the ratio of E/e′ was calculated.

The modified Simpson rule was used to calculate LV volumes and EF. LA anterior–posterior (AP) diameter was measured at end-systole from the parasternal long-axis view. The prolate ellipse method was used to calculate LA volume from apical 4-chamber and parasternal long-axis views at ventricular end-systole, and then LA volumes were indexed to body surface area. A left atrium volume index (LAVI) of 28 mm^3/m^2 or more, which is recommended by the American Society of Echocardiography guidelines as a cutoff to identify patients with normal LA size,[15] was used to dichotomize patients and to plot Kaplan–Meier curves demonstrating stroke recurrence-free rate over time. Therefore, the patients were divided into 2 groups: group A (LAVI >28 mm^3/m^2, n = 59) and group B (LAVI ≤28 mm^3/m^2, n = 193).

Patient Management and Follow-up

During hospitalization, all patients were monitored by continuous ECG recordings. At the first diagnosis of ischemic stroke, the patients were evaluated for the presence of a cardioembolic source using standard ECG, 24-hour Holter monitoring, and echocardiography. Antiplatelet treatments (aspirin, clopidogrel, or triflusal) were prescribed after the absence of a cardioembolic source, such as visible intracardiac thrombus or documented AF, was confirmed. All patients were scheduled