Multidetector computed tomography may be an adequate screening test to reduce periprocedural stroke in atrial fibrillation ablation: A multicenter propensity-matched analysis

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BACKGROUND Whether routine transesophageal echocardiography (TEE) in addition to multidetector computed tomography (MDCT) has incremental value in preventing periprocedural stroke before atrial fibrillation (AF) ablation is unclear.

OBJECTIVE The purpose of this study was to evaluate whether screening with MDCT is sufficient for preventing periprocedural stroke.

METHODS From 4 tertiary centers, we enrolled 1147 patients (902 males, age 57 ± 11 years) with optimal anticoagulation and preserved left ventricular ejection function who had undergone MDCT and routine TEE (group 1, n = 678) or selective TEE (group 2, n = 469) as screening tests before AF ablation. Based on a propensity score analysis, 2 groups with 412 matched pairs were created.

RESULTS Patient baseline characteristics were comparable between the matched groups. In group 1 (n = 412), thrombi were detected in 4 patients (1.0%) on TEE, and ablation was not performed. These patients also showed thrombi (n = 3) or blood stasis (n = 1) on MDCT. For thrombi detection, MDCT had sensitivity and negative predictive value of 100%. In group 2 (n = 412), thrombi were detected in 7 patients (1.7%) on MDCT. Of these patients , 2 (0.5%) also showed thrombi on TEE. Periprocedural stroke incidence did not differ between the groups (0.2% each, $P = 1.0$).

CONCLUSION The incidence of periprocedural stroke was low and did not differ significantly between the group assigned to routine TEE vs selective TEE screening in AF patients undergoing anticoagulation therapy if the patients had conditions associated with low thrombus risk. Thus, preprocedural TEE may not be necessary before AF ablation in patients who have undergone preprocedural cardiac MDCT that shows no evidence of left atrial appendage thrombus.

KEYWORDS Stroke; Atrial fibrillation; Transesophageal echocardiography; Computed tomography

ABBREVIATIONS AF = atrial fibrillation; **AscAo** = ascending aorta; **CT** = computed tomography; **HU** = Hounsfield unit; **INR** = international normalized ratio; **LA** = left atrium; **LAA** = left atrial appendage; **LVEF** = left ventricular ejection fraction; **MDCT** = multidetector computed tomography; **RFCA** = radiofrequency catheter ablation; **SEC** = spontaneous echo contrast; **TEE** = transesophageal echocardiography

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Introduction

Atrial fibrillation (AF) is common sustained cardiac arrhythmia that affects between 1% and 2% of the population.[1,2] It is associated with considerable morbidity, including cardioembolic stroke.[3,4] Radiofrequency catheter ablation (RFCA) is recommended and is widely accepted as a treatment of drug-refractory AF.[5] However, previous studies indicate that RFCA carries a risk of thromboembolism, with an incidence of 0.3% to 5.4%.[6,7] Therefore, preprocedural transesophageal

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echocardiography (TEE) is routinely performed to screen for left atrial (LA) or left atrial appendage (LAA) thrombi, despite its semi-invasiveness and the associated physical discomfort.

Multidetector computed tomography (MDCT) has rapidly advanced as a 3-dimensional imaging modality. Most patients scheduled for RFCA for AF undergo MDCT to examine the pulmonary venous and LA anatomy and to improve the accuracy of the electroanatomic maps by image integration.[8,9] Furthermore, a recent meta-analysis demonstrated that MDCT is a reliable alternative to TEE for LA and LAA thrombi detection, particularly when delayed imaging is performed.[10] However, whether MDCT screening is sufficient for preventing periprocedural stroke is unclear. Therefore, the aim of this propensity-matched, multicenter study was to determine the clinical impact of an additional preprocedural TEE on the incidence of periprocedural stroke and the accuracy of MDCT in detecting thrombi within the context of real-world clinical practice.

Methods

Study population

Between January 2006 and March 2013, we retrospectively enrolled 1147 consecutive patients with nonvalvular AF who had undergone RFCA at 4 tertiary hospitals in Korea. All patients underwent 64-channel MDCT before RFCA, and they underwent preprocedural TEE routinely or selectively at the operator's discretion. Patients were classified into 2 groups based on the strategy for TEE: group 1 (n = 678) underwent routine preprocedural TEE, and group 2 (n = 469) underwent selective TEE. Most patients in group 2 did not undergo TEE; rather, selective TEE was performed in cases where thrombi or blood stasis was detected on MDCT.

All antiarrhythmic medications, including beta-blockers and calcium blockers, were withheld for >5 half-lives before the study. The paroxysmal AF group included patients with a history of ≥1 episodes of self-terminating AF that lasted <7 days. The persistent AF group comprised patients who had experienced AF episodes that either had lasted >7 days or required termination by cardioversion with drugs or electrical therapy. To stratify the risk of stroke and thromboembolism, the $CHADS_2$ score (congestive heart failure, hypertension, age ≥75 years, diabetes mellitus, previous stroke [double risk weight]) and the CHA_2DS_2-VASc score (which includes the additional risk factors of vascular disease, age between 65 and 74 years, and gender; compared to the $CHADS_2$ score, age ≥75 years and stroke carry a double risk weight) were assessed.[11] Bleeding risk was evaluated using HAS-BLED (hypertension, abnormal renal/hepatic function, stroke, bleeding history, labile international normalized ratio [INR], elderly, drug/alcohol concomitantly).[11]

The study protocol was approved by the hospitals' institutional review boards. The study received ethics committee approval from each hospital and complied with the Declaration of Helsinki.

Cardiac MDCT

A 64-slice MDCT was performed using a standard LA protocol at each hospital. A 60- to 80-mL bolus of iopamidol was injected into an antecubital vein at a flow rate of 5 mL/s, followed by a 50-mL saline-chasing bolus at 5 mL/s. Start delay was defined by bolus tracking in the ascending aorta (AscAo), and scan start was automatically initiated 5 seconds after reaching a threshold of 140 Hounsfield units (HU). The following parameters were used for scanning: retrospective ECG-gated acquisitions (spiral mode), 80 to 120 kVp, and 500 to 700 mAs, depending on the patient's size, and 64 × 0.6-mm slice collimation. Scans were performed from the tracheal bifurcation to the diaphragm. The field of view was adjusted according to the heart size. The MDCT images were reconstructed at the end-systolic and mid-diastolic phases using a 0.75-mm slice thickness, an increment interval of 0.5 mm, and a medium-smooth convolution kernel of B36f. We used end-systolic MDCT images for this study. Thrombus or blood stasis was defined as a filling defect (LAA/AscAo HU ratio <0.75) with and without definite margins, respectively. The computed tomographic (CT) images were independently reevaluated in random order by 2 radiologists (with 4 and 8 years of experience in cardiac CT, respectively) who were unaware of clinical characteristics and patient grouping. Interobserver variations to the classification of thrombus vs blood stasis showed substantial agreement (kappa = 0.83).

Echocardiography

TEE was performed at each hospital using a 5- to 7-MHz multiplane probe positioned at the appropriate level within the esophagus. The LAA emptying velocities and the presence of thrombi or spontaneous echo contrast (SEC) were evaluated. SEC was characterized by dynamic clouds of echoes curling slowly in a circular or spiral shape within the LAA and LA and classified into 4 grades. Mild SEC was defined as minimal echogenicity that was only transiently detectable with optimal gain settings during the cardiac cycle. Moderate SEC was defined as a dense swirling pattern of echoes during the entire cardiac cycle. Severe SEC was defined as an intense echogenicity and slow swirling pattern, usually with similar echogenicity in the main cavity.

Anticoagulation

Warfarin was routinely administered before the procedures and continued during the procedures. The therapeutic INR target range was 2 to 3. The INR was checked on a weekly basis before the procedure. During catheter ablation, after the transseptal punctures, initial bolus doses of unfractionated heparin (75–100 IU/kg) were administered. Activated clotting times were routinely monitored throughout the procedures and maintained with either periodic heparin boluses and/or constant infusions. The intensity of heparinization (i.e., activated clotting time) was targeted to >300 seconds.

At the end of each procedure, heparin therapy was stopped for 4 to 6 hours to achieve an empirically determined reduction in the activated clotting time to allow sheath removal. If the