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Stand-Alone Left Atrial Appendage Excision *via* a Thoracoscopic Approach for Secondary Stroke Prevention in NV Afib Patients

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Abstract

Objectives: To determine the efficacy of thoracoscopic stand-alone left atrial appendectomy for stroke prevention in nonvalvular atrial fibrillation.

Background: It is suggested that left atrial appendectomy provided a potential alternative to oral anticoagulation as against AF-induced stroke prevention.

Methods: Consecutive participants were enrolled at the First Affiliated Hospital of Nanjing Medical University between January 2015 and December 2021 who had nonvalvular AF as well as a history of stroke or a systemic thromboembolic event using an endoscopic cutter, the left atrial appendage were thoracoscopically resected.

Results: Thirty-six patients (23 male, median age, 67 years) were finally included with a median AF duration of 60.0 (IQR 24.0-120.0) months. Patients had a median CHADS2 score of 3.0 (IQR 2.0-3.0), CHA2DS2-VASC score of 4.0 (3.0-4.0), and HAS-BLED score of 3.0 (2.0-4.0), respectively.

A previous stroke or transient ischemic attack had occurred in 26 (72.2%) of the patients, and hemiplegia had occurred in 12 (33.3%) of the patients. Twenty patients had a history of bleeding and were not eligible for anticoagulation treatment, while 15 had received warfarin as an anticoagulant. There was a median follow-up time of 40.2 (IQR 33.0-50.2) months. Eighteen individuals had brain computed tomography and/or MRI at follow-up. Eight individuals only underwent anti-platelet medications; the remaining patients all avoided re-anticoagulation. At 6 months and 18 months of follow-up, there were 2 deaths as a result of cerebral hemorrhage incidents.

Conclusion: Thoracoscopic stand-alone appendectomy is an effective and safe technique for nonvalvular atrial fibrillation patients, which offered satisfactory mid-term prophylaxis without using anticoagulation therapy.

Keywords: Left Atrial Appendectomy; Atrial Fibrillation; Thoracoscopy; Thromboembolic stroke

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Introduction

Thrombus buildup in the left atrial appendage is a significant contributor to Thromboembolic Stroke (TES) in Atrial Fibrillation (AF), which is thought to be responsible for 50% of AF associated with valvular disease and 90% of TES in Non-Valvular Atrial Fibrillation (NVAF) [1]. AF can cause TES to occur up to five times more frequently [2]. In order to reduce AF-induced stroke, Blackshear et al. [3] developed the thoracoscopic surgery for LAA closure. With the goal of preventing stroke and other thromboembolism recurrence, we have used this group of patients to design a new thoracoscopic technique to entirely remove the LAA from its base. In 14% to 40% of AF patients who are at risk of stroke, long-term oral anticoagulation [4]. Utilizing recently made available oral anticoagulants, such as dabigatran, is still problematic for older patients since they are at an increased risk of bleeding [5]. However, those who have a significant risk of bleeding can avoid life-long anticoagulation *via* a minimally invasive procedure. In a stand-alone manner, thoracoscopic stand-alone appendectomy may be risk-free and enable surgeons to perform a complete, straight-forward LAA closure [6]. Thoracoscopic LAA closure seems to be a viable substitute for percutaneous procedures that do not require dual antiplatelet or anticoagulants treatment in NVAF patients with high bleeding risk (HAS-BLED score >3) [7]. When compared to the non-occlusion procedure, surgical LAA occlusion was associated with a reduction in the incidence of ischemic stroke, systemic embolism, and overall mortality [8]. It is known that concurrent surgical LAA occlusion, as opposed to the non-occlusion procedures, was related to a decreased risk of future stroke and overall mortality in patients undergoing cardiac surgery [9]. When long-term oral anticoagulation is challenging for patients with NVAF, particularly those with a big or complex LAA, the minimally invasive off-pump approach shows potential as an efficacious alternative [10]. Our study aimed to bring a real-world outcome of LAA excision in NVAF patients who are at high risk of stroke and hemorrhage, and to contribute to proving this procedure is clinically significant and meaningful in preventing TES in such patients.

Methods

Selection criteria

This study enrolled consecutive patients with nonvalvular AF and a previous stroke or systemic thromboembolic event who underwent thoracoscopic LAAE at Nanjing Medical University's First Affiliated Hospital between January 2015 and December 2021.

Patients who fulfilled the following criteria were included: (1) age 18 to 80 years; (2) an ischemic stroke, Transient Ischemic Attack (TIA), or systemic thromboembolism; (3) Ablative therapy was expected to be refractory to ablative treatment. We performed magnetic resonance imaging angiography and ultrasound to obviate potential ischemic causes of the thromboembolism and confirmed its LAA in origin.

The following were the exclusion standards: A history of rheumatic heart disease or severe valvular heart disease or previous valve replacement and other diseases that require lifelong anticoagulation treatment. If AF was expected to be responsive to ablation, the patients underwent extracardiac radiofrequency ablation thoracoscopically and were excluded from the study.

An observational prospective cohort study was conducted. The research protocol was accepted and approved by the Institutional Review Board of the First Affiliated Hospital of Nanjing Medical University (2021-MD-164).

Surgical procedure

A cardiac surgeon who is skilled in Thoracoscopic assisted cardiac surgery performed the procedures on all of the patients. All patients were placed in the right lateral recumbent position after being anesthetized using a double-lumen endotracheal tube. In order to display the LAA and direct LAA resection, Transesophageal Echocardiography (TEE) was carried out when the patient was in the ideal position. The left lung was spontaneously deflated. Three ports in the chest wall were used during the procedure. After performing left single-lung ventilation, the technique was first started on the right side. On the midaxillary line, the camera port (5 mm) was inserted in the fourth intercostal space. On the anterior-axillary line, the other two working ports (5 mm and 12 mm) were positioned in the third and fifth intercostal spaces, respectively. The operating field was expanded using carbon dioxide insufflation at 8 mmHg to 10 mmHg. Just above the LAA and 2 cm anterior to the left phrenic nerve, a 5-cm-long pericardiotomy was performed. The endoscopic cutter was placed into the chest, and the LAA was divided at its base (Figure 1). In the pleural cavity, a single chest tube was left in place [11]. An endoscopic Ethicon stapler was used to close the LAA excision site. (Ethicon EndoSurgery, Inc., Cincinnati, Ohio) or Permed stapler (Permed Biomedical Engineering Co., Ltd) with TEE guidance. cardioversion was carried out right away when AF still persisted.

Clinical endpoints

Cerebral thromboembolic events, such as TIA, ischemic stroke, and noncentral nervous systemic embolism, were the main consequences. Secondary outcomes include the length of mechanical ventilation, hospital stays, and death.

Follow-up

Patients were followed up on 1, 3, 6, 9, and 12 months after the surgery, as well as every 6 months subsequently, to determine both primary and secondary outcomes. Brain CT or MRI were carried out annually. The brain CT and MRI data were evaluated by a stroke specialist. The clinical reports of all primary and secondary events were scrutinized by a specialized committee for clinical event adjudication.

Statistical analysis

Depending on the nature of variable the continuous data were displayed using the median (Interquartile Range [IQRs]) and percentages (%) were used to express the category data. R, version 3.6.1, was used to conduct all statistical analyses (R Foundation for Statistical Computing).

Results

In this investigation, a total of 36 patients were involved. including 23 male and 13 female subjects (median age, 67 years [IQR 65-74]; range, 47 to 81 years) (Table 1). Patients had median AF duration of 60.0 (24.0-120.0) months. Of all patients, there were 28 (77.8%) hypertension history, 6 (16.7%) diabetes history, 8 (22.2%) smoking, 9 (25.0%) alcohol consumption, 25 (71.4%) coronary heart disease history, 17 (48.6%) carotid artery plaque history, and 11 (30.6%) hyperthyroidism.

Patients had a median CHADS2 score of 3.0 (IQR 2.0-3.0), CHA2DS2-VASC score of 4.0 (3.0-4.0), and HAS-BLED score of 3.0 (2.0-4.0), respectively. In all patients, the median left atrial diameter was 45.0 (42.0-46.0) mm. Twenty-six (72.2%) patients had a previous stroke and/or Transient Ischemic Attacks (TIAs), and 12 (33.3%) patients had hemiplegia. Fifteen patients had received warfarin for anticoagulation, and 20 had bleeding history, with anticoagulation contraindication.

Surgery took a median operation time of 51.0 (IQR 42.2-62.0). There was no any switching to mini-thoracotomy because of pleural or pericardial adhesions. All patients had a spontaneous echo contrast in the LAA that was seen by intraoperative TEE but quickly disappeared following appendectomy (Figure 2A, 2B). There were two bendable cut-and-staple devices used including Permed 6 (16.7%) and Ethion 30 (83.3%) (Table 1).

The median mechanical ventilation duration was 3.0 (1.0-3.2) days. The average postoperative hospital stay was 7 days (IQR 5 to 9 days). There was no postoperative mortality or new stroke occurrence. Eight (22.9%) of the preoperatively medicated subgroup patients continued using aspirin, but after left atrial appendectomy, all patients discontinued warfarin. There was a median follow-up time of 40.2 (IQR 33.0-50.2) months. At follow-up, 18 patients completed cerebral computed tomography and/or magnetic resonance images.

It was confirmed that there were no LAA stumps or clots in the left atrium in all patients (Figure 3A, 3B).

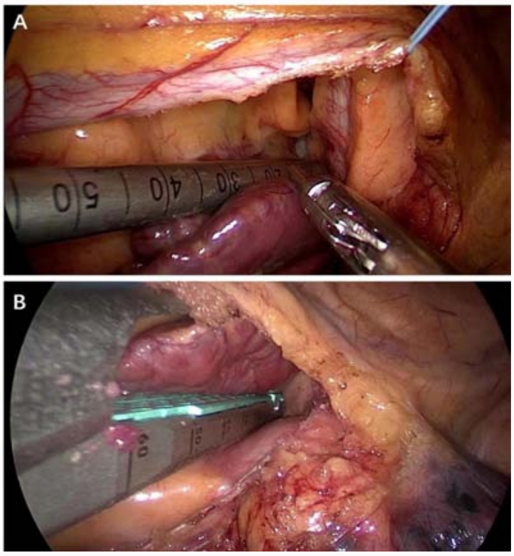

Figure 1: Intraoperative direct measure of left atrial appendage (A) and thoracoscopic left atrial appendage excision (B).

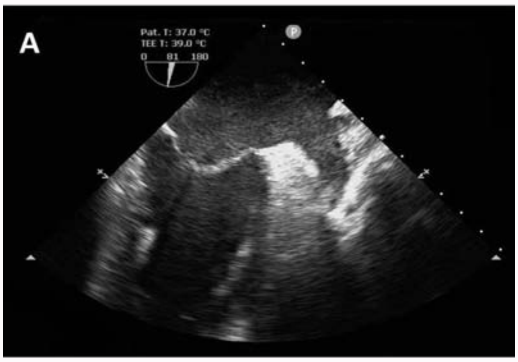

Figure 2(A): Intraoperative Transesophageal Echocardiographic image before complete excision of the left atrial appendage.

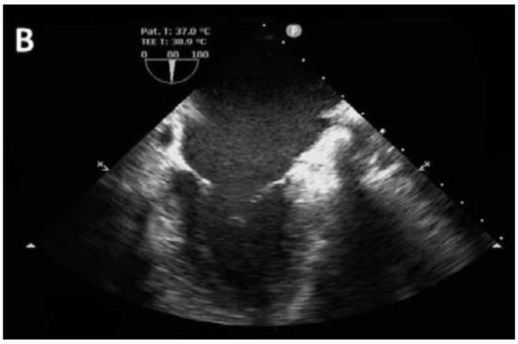

Figure 2(B): Intraoperative Transesophageal Echocardiographic image after complete excision of the left atrial appendage.

All patients avoided re-anticoagulation, and 8 patients received antiplatelet therapy alone. Two patients had new onset of stroke at 30 months and 36 months of follow-up. There were 2 deaths due to cerebral hemorrhage accident at 6 month and 18 months of follow-up (Table 2).

Discussion

In this cohort of patients with NVAF who are at significant risk

Table 1: Baseline and clinical characteristics.

Demographic variables	
Age (years)	67.0 (64.8-74.2)
Sex male, n (%)	23 (63.9%)
Weight (Kg)	67.0 (60.0-75.0)
Medical history and risk factors	
AF course (months)	60.0 (24.0-120.0)
Hypertension, n (%)	28 (77.8%)
Diabetes, n (%)	6 (16.7%)
Stroke history, n (%)	26 (72.2%)
Hemiplegia history, n (%)	12 (33.3%)
Bleeding history, n (%)	20 (55.6%)
Smoking, n (%)	8 (22.2%)
Drinking, n (%)	9 (25.0%)
Prior ablation, n (%)	2 (5.6%)
NYHA class, n (%)	
I	5 (13.9%)
II	24 (66.7%)
III	7 (19.4%)
Coronary heart disease, n (%)	25 (71.4%)
Carotid artery plaque, n (%)	17 (48.6%)
Hyperthyroidism, n (%)	11 (30.6%)
CHADS2 score	3.0 (2.0-3.0)
CHA2DS2-VASC score	4.0 (3.0-4.0)
HAS-BLED score	3.0 (2.0-4.0)
Laboratory variables	
Brain natriuretic peptide (pg/ml)	748.8 (618.3-1123.0)
Creatine kinase-MB (ng/ml)	6.6 (5.0-10.0)
Cardiac troponin T (ng/l)	15.0 (9.0-34.8)
Myohemoglobin (ng/ml)	21.0 (13.2-40.8)
Coagulation function	
Prothrombin time (s)	13.0 (12.2-13.9)
D-dimer (mg/l)	0.2 (0.1-0.5)
Activated partial thromboplastin time (s)	31.5 (29.1-34.4)
Biochemical variables	
Cholesterol (mmol/l)	3.3 (2.9-3.9)
Triglyceride (mmol/l)	1.0 (0.7-1.3)
High-density lipoprotein-cholesterol (mmol/l)	1.1 (0.9-1.2)
Low-density lipoprotein-cholesterol (mmol/l)	1.8 (1.6-2.3)
Lipoprotein a (mg/l)	136.5 (74.5-310.5)
Alanine transaminase (u/l)	17.1 (11.8-24.9)
Aspartate aminotransferase (u/l)	21.9 (17.9-26.3)
Echocardiographic variables	
Aorta diameter (mm)	32.0 (30.0-34.0)
Left atrial diameter (mm)	45.0 (42.0-46.0)
Left ventricle end-diastolic diameter (mm)	47.0 (45.0-48.5)
Left ventricle end-systolic diameter (mm)	31.0 (30.0-32.5)
Left ventricular posterior wall thickness (mm)	10.0 (10.0-10.0)
Fraction shortening (%)	34.0 (33.3-34.7)
Interventricular septum (mm)	10.0 (10.0-11.0)
Left ventricle ejection fraction (%)	62.2 (61.0-63.4)
Pulmonary arterial systolic pressure (mmHg)	26.0 (25.2-30.0)

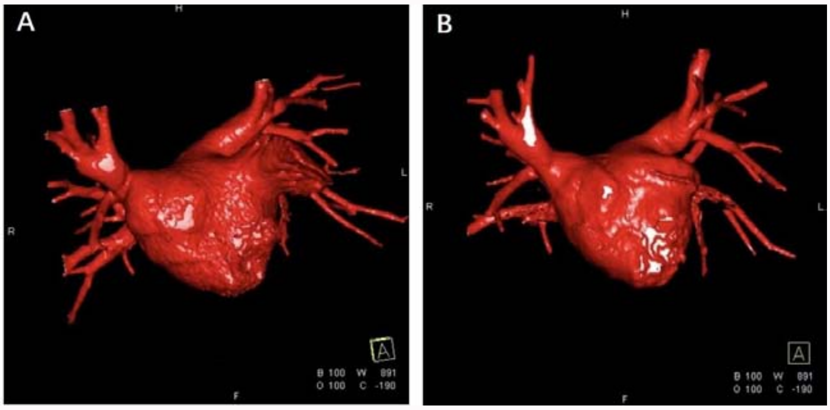

Figure 3: Three-dimensional left atrial enhanced computed tomographic images taken before (A) and 1 month after surgery (B).

for bleeding, the therapeutic effectiveness of thoracoscopic LAA excision in preventing subsequent stroke is assessed in this cohort research.

Our first findings point to a technique that holds promise for managing these high-risk individuals in a medical environment where maintaining anticoagulation might be difficult.

A high-risk group for recurrent stroke and bleeding is AF patients who have previously experienced an ischemic stroke or TIA [12,13]. In Asians [14], particularly the Chinese population, are more affected by this phenomenon [15,16].

The new oral anticoagulants are safer than warfarin in terms of bleeding [17,18]. The predicament of preventing stroke while lowering the danger of bleeding has plagued physicians for many years. Currently, LAA occlusion is regarded as an alternate strategy for stroke prevention [19]. However, considering that these patients being in a greater risk of bleeding, periprocedural antiplatelet plus anticoagulant medication may not be appropriate. Anticoagulant therapy often presents the most challenge to AF patients with a history of thrombosis episodes [20]. This particular demographic has a high risk of bleeding and recurrent thromboembolism. Anticoagulant treatment is sometimes properly used for secondary stroke prevention [21]. If adequate mitigation measures are not put in place, it is predicted that the number of strokes caused by atrial fibrillation would significantly rise in the future. Atrial fibrillation has been linked to a higher risk of stroke and it is known to be significantly decreased by systemic anticoagulation. Effective anticoagulant therapy is hampered by bleeding issues and nonadherence. Nonpharmacologic approaches to lessen the drawbacks of medication therapy include surgical and percutaneous left atrial appendage closure devices [22,23]. Surgeons have made numerous attempts to treat the LAA in order to prevent strokes. Both surgical sutures (endocardial, epicardial, amputation) and technical equipment's (EndoLoop or AtriClip) are typically needed for these surgical techniques [24].

The introduction of the surgical Maze technique during the 1990s, for the treatment of AF and the widespread use of TEE coincided with a resurgence of interest in surgical LAA resection or occlusion [23]. Despite the fact that these procedures are frequently performed concurrently with other cardiac surgeries, they appear to have favorable effects on the long-term effectiveness of stroke prevention [25,26]. Numerous strategies for ligation or excision of the LAA have been created. The LAA can now be removed surgically using the following methods: Excision, Endometrial double-layer vertical suture closure, epicardial stapling, or clip implementation [27]. Stroke prophylaxis in individuals with nonvalvular AF has also recently been accomplished by stand-alone left atrial appendectomy [6,10]. In patients with persistent AF, the LA remodels, and the LAA becomes a static pouch. The propensity for thrombus formation rises as Doppler flow velocity decreases during AF [28]. Experiments have also shown that the cardiac output is barely influenced by the LAA's mechanical activity, Therefore, eliminating or sealing the LAA won't significantly affect hemodynamics [29].

A crucial step in preventing stroke is to perform the entire LAA excision. Complete excision is frequently challenging because of the complicated architecture of the LAA, which has a wide range of ostia and morphologies. Therefore, preoperative CT reconstruction of the LAA anatomy with TEE intraoperative guidance can increase the success rate of full excision. However, the improper stapler angle is another cause of incomplete excision or a left stump. The failure of full excision can be significantly minimized if the stapler angle is adjusted to an ideal site approximately parallel to the LAA ostium's long axis. The frequency of thromboembolic events may rise following a stand-alone LAA excision, according to earlier research [30,31]. Even though there was a prevalence of LAA, these outcomes were not seen over the follow-up period of the current investigations. Furthermore, our preliminary findings support the viability and safety of this strategy, which will be further investigated in more extensive research.

Limitations

One of the limitations is the retrospective nature, with inherent flaw. And, the sample size is also small. The lack of a control group restricts the utilization of pond treatment system, Hence, a controlled trial or sizable cohort research ought to be carried out. Radiologists evaluated our imaging results, including the extent of the LAA closure, while they had access to the other clinical data. Therefore, our clinical results are limited to enable us to extrapolate the benefits of the procedure.

Conclusion

Thoracoscopic stand-alone LAA appendectomy is a potentially safe strategy to remove the LAA with a simple procedure, which would benefit individuals at risk of thromboembolisms who were expected to be refractory to ablative treatment with anticoagulation contraindication. Although long-term results are needed to confirm our findings, this minimally invasive technique provide a promising option for thromboembolism prevention for NVAF patients with long-term anticoagulation intolerance.

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