A Case of Cardiogenic Stroke After Thoracoscopic Left Atrial Appendectomy

Ruriko Numata, MD, Takafumi Inoue, MD, Akihiro Yoshimoto, MD, Masayuki Fujisaki, MD, Sei Morizumi, MD and Yoshihiro Suematsu, MD

Summary
Thoracoscopic left atrial appendectomy is a minimally invasive procedure for left atrial appendage occlusion in patients with non-valvular atrial fibrillation, particularly those at a great risk for both stroke and bleeding despite appropriate oral anticoagulant therapy. It serves as an alternative strategy for stroke risk reduction. Moreover, the oral anticoagulant therapy can be discontinued after the operation. However, we encountered a 74-year old male patient who developed cardiogenic stroke after thoracoscopic left atrial appendectomy. We report this case to introduce how we evaluate the risk of postoperative cardiogenic stroke by means of contrast-enhanced cardiac computed tomography (CT), and how we formulate the postoperative patient management strategy including short-term oral anticoagulation therapy by using results of cardiac CT.

Key words: Thromboembolism, Atrial fibrillation, Bleeding risk, Contrast-enhanced cardiac CT

Thoracoscopic left atrial appendectomy is a surgical procedure for left atrial appendage closure carried out using an endoscopic linear stapler and loop snare in the setting of video-assisted thoracoscopic surgery. It is aimed at preventing stroke and other complications of thromboembolism in patients with non-valvular atrial fibrillation (AF). The procedure is based on the observation that at least 90% of left atrial thrombi are found in the left atrial appendage (LAA). Ohtsuka, et al. reported thoracoscopic appendectomy as an effective alternative to oral anticoagulant therapy (OAC) in patients in whom OAC is contraindicated, or those who cannot tolerate or are refractory to OAC, with good outcomes and low rates of subsequent thromboembolism.

However, we encountered a case in which cardiogenic stroke developed after thoracoscopic left atrial appendectomy. Therefore, we would like to report the case as well as introduce our strategy for minimizing the risk of cardiogenic thromboembolism after left atrial occlusion.

Case Report
The patient was a 74-year-old man with a history of chronic AF, hypertension, type 2 diabetes mellitus and recurrent sigmoid diverticular hemorrhage. His CHADS2 score was 2 (hypertension, diabetes mellitus) and CHA2DS2-VASc score was 3 (hypertension, age between 65-74 years, diabetes mellitus); OAC was strongly recommended for stroke prevention. Warfarin was prescribed with a target prothrombin timeinternational normalized ratio (PT-INR) of 2.0-3.0. His HAS-BLED score was 4 (hypertension, > 65 years old, prior major bleeding, alcohol use); he was also at high risk for major bleeding. After weighing the risks and benefits of OAC, left atrial appendectomy had been selected and performed at another hospital, then OAC was subsequently discontinued.

About 5 months later, he suddenly developed leftsided hemiparesis with altered consciousness and was transported immediately to a hospital. MRI revealed a high-intensity signal in the middle cerebral arterial territory of the right hemisphere and a diffusion-weighted sequence with Magnetic resonance arteriography (MRA) showed signal defects in a branch of the middle cerebral artery. (Figure 1A, B) He was successfully treated by urgent thrombolysis using tissue plasminogen activator and recovered without any neurological sequelae. Before he was discharged from the hospital, OAC (warfarin 2 mg/day) was restarted as prophylaxis against stroke recurrence.

Twenty three days after the occurrence of the cardiogenic ischemic stroke, the patient was referred to our hospital for investigation of the possible source of the emboli. At the time, the patient had a CHADS2 score of 4 and a CHA2DS2-VASc of 5. The PT-INR was 1.9, which was slightly below the therapeutic range; the results of other blood tests revealed no significant abnormalities. Transthoracic echocardiography showed no asynergy of left ventricular wall motion and an ejection fraction of 55%. The left atrial diameter was 41 mm and there was...
no atrial thrombus. Trans-esophageal echocardiography (TEE) showed no atrial thrombus either, but the mean flow velocity in the left atrium was as low as 20 cm/sec with spontaneous echo contrast. Contrast-enhanced cardiac computed tomography (CT) did not exhibit filling defects in both early (Figure 2A) and delayed phase (Figure 2B). Three-dimensional reconstruction of left atrium from this postoperative cardiac CT demonstrated that the LAA had been resected from its base without leaving stumps. (Figure 2C) After performing above mentioned thorough examinations to find the source of emboli, we concluded that there was no other plausible source of emboli other than the atrial clot along the stapling line of thoracoscopic left atrial appendectomy. Accordingly, the patient continued warfarin for 3 months.

A follow-up contrast-enhanced cardiac CT was performed after 3 months of OAC therapy. At that time, no filling defect was visualized in either early or delayed phase. After re-assessment of the risks and benefits of OAC, the patient discontinued OAC. Currently, the patient remains well, with no episode of either major bleeding or cardiogenic stroke.

**Discussion**

After thoracoscopic left atrial appendectomy, OAC is usually discontinued, because the LAA has already been excluded, and absence of an atrial thrombus had been confirmed by TEE before the operation. However, the possibility of postoperative LA thrombus formation remains, especially during early postoperative period. Aizawa, et al. reported a case of giant atrial thrombus formation immediately after mitral valvuloplasty and LAA resection performed as an open heart procedure. Due to this concern, we routinely perform cardiac contrast-enhanced CT on the 2nd postoperative day. From our experience, we found that thrombus along the stapling line was formed approximately 27% of cases (19 out of 70 cases) after thoracoscopic left atrial appendectomy.

Contrast-enhanced cardiac CT is a highly reliable procedure with accuracy comparable to that of TEE for identification of a left atrial thrombus. Especially for postoperative evaluation, contrast-enhanced cardiac CT is more useful than TEE, because metal artifacts from the linear stapler make it difficult to accurately visualize staple-line thrombus by TEE. For patients with chronic kidney disease (CKD), prevention of contrast induced
nephropathy is required. For this purpose, we give prophylaxis such as hydration with saline and ingestion of acetylcysteine before and after performing the contrast-enhanced CT.

When we perform postoperative contrast-enhanced cardiac CT, we closely examine the presence of filling defect in the left atrium, especially near the stapling line. If no filling defect is seen inside the left atrium, the patient no longer needs anticoagulation. If a filling defect is found in both early and delayed phases, it means that thrombus developed after the operation. Consequently, warfarin or direct oral anticoagulants (DOAC) is continued for at least 3 months. Following 3-month OAC therapy, a contrast-enhanced cardiac CT is performed again. If the filling defect is no longer visualized, the OAC therapy can be discontinued.

Back to this patient, he had high CHADS\textsubscript{2} and/or CHA\textsubscript{2}DS\textsubscript{2}-VASc score, meanwhile he had high HAS-BLED score, indicating that he was at high risk for stroke and bleeding concurrently. We believe that discontinuation of OAC after removal of LAA can be justified especially for those who have high bleeding risk, but optimal therapy for these patients with concurrent high stroke and bleeding risk remains unclear.

We developed this strategy because we do recognize that there is substantial risk of developing clot in the left atrium especially just after the procedure. However, by applying our strategy as previously described, the risk of embolic complications can be minimized and discontinuation of OAC therapy can be eventually achieved.

Ohtsuka, et al. reported other complications after thoracoscopic left atrial appendectomy such as minor air leakage, prolonged drainage, and minor wound complication.\textsuperscript{2} In our department, we had similar complications such as minor bleeding, minor air leakage and prolonged drainage but have not experienced serious complications such as systemic thromboembolic events, cardiac events, pulmonary morbidity, left phrenic palsy, and death.

From the technical points of view, previous studies demonstrated that incomplete resection of LAA may lead to continued clot formation and stroke recurrence.\textsuperscript{3} In our technique, the endoscopic cutter is introduced from a port established in the 7th or 8th intercostal space in the posterior axillary line. The angle of the cutter is optimized under the thoracoscopic guidance before ligation. Furthermore, the edge of stapling line is compensated by loop snare in order not to leave any stump. Besides, after ligation, intraoperative TEE is performed to verify complete resection of LAA.

In conclusion, thoracoscopic left atrial appendectomy may serve as an alternative management strategy for patients who are at a high risk of developing stroke and bleeding by OAC therapy. Regardless of the CHADS\textsubscript{2} and/or CHA\textsubscript{2}DS\textsubscript{2}-VASc score, postsurgical evaluation by contrast-enhanced cardiac CT is essential for determining the need for postoperative anticoagulation therapy. If necessary, use of OAC for a short period, usually 3 months, in selected patients can improve the outcomes of the operation.

Disclosures

Conflicts of interest: None.

References