

Thrombus formation on the ablation line after pulmonary vein isolation with a cryoballoon

Yoshiki Kitazumi¹, Daisuke Yuji¹, Kouichi Nagashima¹, Akira Sezai², and Masashi Tanaka¹

¹Nihon Daigaku Igakubu Fuzoku Itabashi Byoin

²Nihon University

May 12, 2020

Abstract

Catheter ablation is a widely accepted therapy for atrial fibrillation (AF), of which stroke is a major complication. A stroke after catheter ablation has been reported in numerous studies not only in the acute phase but also in the chronic phase. A 66-year-old man with drug refractory paroxysmal AF underwent catheter ablation. Fourteen months later, the patient was diagnosed with cerebral infarction. Transesophageal echocardiography detected an ovoid mass on the anterior aspect of the right superior pulmonary vein atrium, where the previous ablation was performed. We report a very rare case of left atrial thrombus formation required surgical treatment 14 months after cryoballoon ablation. Careful follow up with multimodalities is necessary for the detection and diagnosis of chronic phase thrombus formation.

Thrombus formation on the ablation line after pulmonary vein isolation with a cryoballoon.

Yoshiki Kitazumi, MD, Daisuke Yuji, MD, PhD, Kouichi Nagashima, MD, PhD, Akira Sezai, MD, PhD, Masashi Tanaka, MD, PhD

Department of Cardiovascular Surgery

Nihon University School of Medicine, Tokyo, Japan

Short running title: Ablation area thrombus formation

Address for correspondence: Kitazumi Yoshiki

Department of Cardiovascular surgery, Nihon University School of Medicine

30-1 Ohyaguchi-kamicho, Itabashi-ku, Tokyo 173-8610, Japan

Tel: +81-3-3972-8111

Fax: +81-3-3972-1098

E-mail: kitazumi.yoshiki@nihon-u.ac.jp

The authors declare no conflicts of interest associated with this manuscript.

Abstract

Catheter ablation is a widely accepted therapy for atrial fibrillation (AF), of which stroke is a major complication. A stroke after catheter ablation has been reported in numerous studies not only in the acute phase but also in the chronic phase. A 66-year-old man with drug refractory paroxysmal AF underwent catheter ablation. Fourteen months later, the patient was diagnosed with cerebral infarction. Transesophageal echocardiography detected an ovoid mass on the anterior aspect of the right superior pulmonary vein atrium, where

the previous ablation was performed. We report a very rare case of left atrial thrombus formation required surgical treatment 14 months after cryoballoon ablation. Careful follow up with multimodalities is necessary for the detection and diagnosis of chronic phase thrombus formation.

Keywords: Left Atrial Thrombus, Atrial Fibrillation, Cryoballoon, Catheter Ablation

Introduction

Catheter ablation by means of radiofrequency (RF) energy or cryoballoon is a widely accepted, non-pharmacological therapy for atrial fibrillation (AF). However procedure-related stroke is a serious complication. Stroke is primarily caused by thromboembolism during the ablation and further appropriate anticoagulant therapy is crucial.¹ Despite appropriate anticoagulation, the stroke may be due to late left atrial (LA) thrombus formation in chronic phase. Only two previous cases of LA thrombus post pulmonary vein isolation (PVI) in the chronic phase have been reported.^{2,3} We encountered a rare case of late detected LA thrombus, following cryoballoon ablation.

Case presentation

A 66-year-old man with drug-refractory paroxysmal AF was referred to our institution for initial catheter ablation. The patient posed a low risk for stroke as he was without any concomitant diseases such as hypertension or hyperlipidemia, only slight high body mass index of 27 kg/m². (CHA2DS2-Vasc score: 1 point). Transthoracic echocardiography (TTE) revealed slight LA dilation that was 39mm in diameter, and transesophageal echocardiography (TEE) detected no LA thrombus. PVI was performed with a 28 mm cryoballoon (ARC-Adv-CB, Arctic Front Advance; Medtronic Inc., Minneapolis, MN) guided by Ensite NavX Velocity mapping (Abbott Laboratories, Abbott Park, IL). Intravenous heparin was administered to maintain an activated clotting time of > 300s during the procedure. Although sustained AF remained inducible after PVI, no additional LA ablation was performed. The patient was managed with oral dose of 100 mg bepridil, 20 mg aprindine, and 5 mg apixaban twice daily. Electrocardiogram (ECG) and Holter monitoring detected no AF recurrence throughout follow-up.

Fourteen months after PVI, the patient arrived at our emergency department with left arm paralysis. Brain computed tomography (CT) and magnetic resonance imaging (MRI) revealed cerebral infarctions of the subcortical regions of bilateral temporal lobes, suggestive of embolic shower. ECG monitoring revealed no AF recurrence during hospitalization. The patient continued to take bepridil and apixaban until admission. TEE detected no thrombus in the LA appendage (LAA), but an ovoid mass 15 mm in diameter was observed on the anterior aspect of the right superior PV antrum (Fig 1A,B). Contrast-enhanced CT revealed that the location of the mass matched the previous ablation area (Fig 1C). Due to the episode of embolic shower, surgical resection was performed to prevent further cerebral infarction. Resection of the LA mass followed by Cox Maze procedure and LAA resection was performed. The mass was 12 mm in diameter above the ablation line, consisted of smoothly marginated soft tissue, and was excised easily (Fig 2A,B). Histologic examination revealed that the thrombus adhered to the LA endocardium. Layers of organized thrombus were formed on endocardium and fibrin thrombi were above them. Part of endocardium was replaced with necrotic tissue and structure of muscle layer was collapsed. Epicardium consists loose collagen fibers with inflammatory cells and neocapillaries are formed (Fig 3). The patient was discharged given the favorable clinical course after surgery. At his several follow up visit, the patient was managed with 100 mg flecainide and 5 mg apixaban twice a day orally, and no recurrence of stroke or AF ensued for 20 months.

Discussion

Cryoballoon ablation-related stroke in the acute phase occurs rarely, with a reported incidence of 0.2%⁴. However, its occurrence in the chronic phase has been unknown. Based on the data, its incidence of LA thrombus formation associated with cryoballoon ablation is estimated to be even lower. In the patient considered here, the mechanism of LA thrombus formation appeared to differ from that of AF, because the patient was at low risk for stroke and symptoms were managed with apixaban. Also, TEE revealed no thrombus of the LAA. Histological findings of thrombus adhesion to the LA endocardium, which had been

replaced with necrotic tissue, might also support our hypothesis. Based on these findings, LA endothelium damage due to the cryo-thermal energy might be a main cause of thrombus formation, although cryoballoon ablation was likely less damaging to LA endothelium or endocardium than ablation⁵. Therefore, adding antithrombotic therapy to anticoagulant therapy might be warranted in these patients. TEE is a useful modality for detecting LA thrombus, most of which occur in the LAA as a result of decreased outflow velocity. However, uncommon thrombus locations such as the septum and previous PVI have been reported^{2,3,6}. In these cases, differentiation of the thrombus from the myxoma is crucial for determining a treatment strategy. Determination of a narrow stroke between a thrombus and myxoma is not always straightforward^{6,7}. Use of multiple modalities, such as CT or MRI, might facilitate a correct diagnosis.

Conclusion

We encountered a rare case with late LA thrombus within a previous cryo-ablation area. When monitoring the AF patients post-ablation, clinicians should be aware of the possibility of late LA thrombus formation despite appropriate anticoagulant therapy. Careful examination with multiple modalities is often necessary for detecting and correctly diagnosing an LA thrombus.

Author Contributions

Y. Kitazumi, MD: Drafting article

D. Yuji, MD: Critical revision of article

K. Nagashima: Critical revision of article

A. Sezai, MD, PhD: Critical revision of article

M. Tanaka, MD, PhD: Critical revision of article, Approval of article

References

1. Fiorenzo G, Domenico C, Martina O, Marco S, Elisabetta T, Federico C, Carlo B, Giovanni G, Maria V, Roberto P, Franck H, Jean L. Radiofrequency Catheter Ablation of Atrial Fibrillation: A cause of Silent Thromboembolism? Magnetic Resonance Imaging Assessment of Cerebral Thromboembolism in Patients Undergoing Ablation of Atrial Fibrillation. *Circulation* 2010;17:1667-1673
2. Suenari K, Hirao H, Ueda H. A protruding lesion on the previous pulmonary vein isolation line in case with paroxysmal atrial fibrillation. *Europace* 2015;17:837
3. Kuroda Y, Minakata K, Yamazaki K, Sakaguchi H, Uehara K, Sakata R. A Giant Left Atrial Thrombus After Radiofrequency Catheter Ablation. *Ann Thorac Surg.* 2016;102:461
4. Mugnai G, de Asmundis C, Ciconte G, Irfan G, Saitoh Y, Velagic V, Stroker E, Wauters K, Hunuk B, Brugada P, Chierchia GB. Incidence and characteristics of complications in the setting of second-generation cryoballoon ablation: A large single-center study of 500 consecutive patients. *Heart Rhythm* 2015;12:1476-1482.
5. Hisazaki K, Hasegawa K, Kaseno K, Miyazaki S, Amaya N, Shiomi Y, Tama N, Ikeda H, Fukuoka Y, Morishita T, Ishida K, Uzui H, Tada H. Endothelial damage and thromboembolic risk after pulmonary vein isolation using the latest ablation technologies: a comparison of the second-generation cryoballoon vs. contact force-sensing radiofrequency ablation. *Heart Vessels* 2019;34:509-516.
6. Gurudevan SV, Shah H, Tolstrup K, Siegel R, Krishnan SC. Septal thrombus in the left atrium: is the left atrial septal pouch the culprit? *JACC Cardiovasc Imaging* 2010;3:1284-1286.
7. Shimamoto K, Kawagoe T, Dai K, Inoue I. Thrombus in the left atrial septal pouch mimicking myxoma. *J Clin Ultrasound* 2014;42:185-188.

Figure Legend

Fig1 A,B,C

A,B A transesophageal echocardiography image of an ovoid mass 15 mm in diameter (arrows) at the anterior aspect of the right superior pulmonary vein antrum is shown.

C Contrast-enhanced computed tomography of location of the mass (red arrow) revealed that it occurred at the previous ablation site.

Fig2 A,B

A A red, soft mass was observed at the cranial aspect of the right upper pulmonary vein orifice, as seen in the preoperative examination.

B The mass had adhered to the previous ablation site and was easily removed. Its size was 15×12 mm.

Fig3

Hematoxylin Eosin stain of specimen from surgery is shown. Scale bar is shown right above in the picture.

Layers of organized thrombus were formed on endocardium and fibrin thrombi were above them. Part of endocardium was replaced with necrotic tissue and structure of muscle layer was collapsed. Epicardium consists loose collagen fibers with inflammatory cells and neocapillaries are formed.







