Early catheter-associated thrombus formation and migration during pulmonary vein isolation: an approach to rule out stroke and carry on the procedure

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ABSTRACT

Introduction: Catheter ablation is a well-known treatment strategy for patients with symptomatic atrial fibrillation. Despite the benefits in controlling symptoms, the procedure can be associated with complications. Among the most threatening complications, thrombus formation has great importance, since it’s associated with embolic events. In this setting, sheath and catheter associated thrombi have become increasingly identified with the use of intracardiac echocardiography. Despite anticoagulation, these thrombi are found in 10% of cases, with clinical complications in up to 1%. Management of these thrombi includes withdrawal of the sheath and catheter when the thrombi are left to be firmly attached, thrombus aspirations and local thrombolysis. Case Report: We describe a case of early sheath thrombus formation after the first transeptal puncture during atrial fibrillation catheter ablation. This was followed by thrombus detachment and migration from the sheath located in the left atrium. Instead of aborting the procedure, which is the standard approach in such situation, patient had anesthesia reversion, neurologic evaluation and procedure resumption without complications. Conclusion: The routine use of intracardiac echocardiography has contributed to detection of early complications during atrial fibrillation catheter ablation, like thrombus formation. Correct anticoagulation during the procedure is essential, as well as the continuous monitoring of thrombus formation. This is the first case report of temporary general anesthesia reversion after LA thrombus migration to rule out stroke.

Keywords: Atrial fibrillation, Catheter ablation, Pulmonary veins, Thrombosis

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INTRODUCTION

Atrial fibrillation catheter ablation is a well-accepted treatment strategy [1]. Despite anticoagulation, sheath- and catheter-associated thrombi have become increasingly identified during left-sided ablation procedures, particularly with the use of intracardiac echocardiography [2–5]. Management of these thrombi includes withdrawal of the sheath and catheter, sheath
aspiration and local thrombolysis [6–8]. Thrombus detachment and embolization can occur. In this situation, procedure abortion is the standard approach [1]. We describe a case of early sheath thrombus formation immediately after the first transeptal puncture during pulmonary vein isolation. This was followed by thrombus detachment and migration from the sheath located in the left atrium. Instead of aborting the procedure, patient had anesthesia reversion, neurologic evaluation and procedure resumption without complications.

CASE REPORT

A 41-years-old man with symptomatic, four years history of paroxysmal atrial fibrillation refractory to antiarrhythmics (including propafenone, sotalol and amiodarone) was brought to the electrophysiology (EP) laboratory for pulmonary vein (PV) isolation. Rivaroxaban use had been discontinued 36 hours prior to the procedure. Pre-ablation evaluation included a transesophageal echocardiogram with normal ejection fraction and no thrombus.

The procedure was performed under general anesthesia. Right and left venous femoral punctures were performed without complications. Intracardiac echocardiogram (ICE) was used for guiding the transeptal catheterization. After femoral sheath access was obtained, a bolus of 5,000 IU of heparin was given intravenously as per local protocol, independently on patient’s body weight (75 Kg). The first transeptal puncture was performed without complications. The long transeptal sheath (Preface, Biosense Webster Inc., Diamond Bar, CA) was advanced through the left atrium (LA). Through this sheath, a 10-pole mapping catheter was then advanced into the left superior PV. Five minutes after heparin bolus and immediately before the second transeptal puncture, the decapolar catheter was noted to have a long (up to 1.5 cm) mobile and freshly formed pedunculated thrombus attached near the distal shaft of the catheter (Figure 1, Video 1).

The activated clotting time (ACT) was found to be 280 s. Additional heparin boluses were required in the next 10 minutes (total of additional 15,000 IU of heparin) before the ACT reached its target of 350 s. While starting attempts to sheath aspiration and catheter withdrawal back into the sheath, the thrombus image suddenly disappeared.

Patient hemodynamic parameters were normal. The bispectral index monitor (BIS) showed stable parameters, without changes in cerebral activity. The general anesthesia was reverted, and patient extubated. An urgent neurological consultation was performed in the EP laboratory, revealing no abnormalities.

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The patient was completely stable in the next 30 minutes. Considering the clinical stability and the fact that AF ablation with tridimensional mapping is expensive and not easily accessible, the procedure was then resumed under general anesthesia with an ACT rigorously targeted at 350 s. Intracardiac echocardiogram was continuously used to monitor thrombus formation. Using the tridimensional mapping system (Carto 3, Biosense Webster, Diamond Bar, CA), LA anatomy and PVs were identifed. The PVs were isolated without further complications (Figure 2). Postoperative investigation revealed no neurological abnormalities. Brain and

Figure 1: Sequential intracardiac echocardiographic images showing the long pedunculated thrombus attached near the distal shaft of the 10-pole catheter.

VIDEO

Video 1: Intracardiac echocardiography showing the 10-pole catheter into the left atrium with a long pedunculated thrombus attached.

Video URL: https://www.idoriums.com/edpanel/preview_article/100991Z01DC2019

Figure 2: (A) Pulmonary vein isolation using the Carto 3 tridimensional mapping system. (B) Intracardiac echocardiographic image showing the 20-pole lasso catheter anchored inside the pulmonary vein without any thrombus attached. (C) Carto 3 image showing the four pulmonary veins isolated at the end of the procedure.
abdominal magnetic resonance image (MRI) showed no evidence of embolization.

DISCUSSION

Thromboembolic events are among the most feared complications of PV isolation. Studies have reported up to 1.4% of cerebral ischemic events, although series of high-volume centers have demonstrated even lower rates (0.42%) of clinical events [2, 9]. The incidence of thrombosis on ICE in the LA, on the other hand, has been considerably more frequent (5.9% to 10%), often preceding RF [3, 6]. More recently, a great number of case reports have shown early thrombus formation in the LA, some immediately after transeptal catheterization [4, 7]. These reports support the notion that placement of electrophysiology catheters, as well as other central venous catheters, could be pro-thrombotic [5, 10].

Transseptal puncture may promote thrombus by endothelial disruption, foreign body introduction and by providing a channel for stasis in a sheath lumen. Despite the great incidence of thrombus visualization, the incidence of clinical complications associated with thrombus is up to 1% [2, 9].

The best-established strategy to prevent thrombus formation has been the use of anticoagulation during the ablation procedure. Most experts report heparinizing to an ACT > 300 s before transeptal catheterization. While in the LA, the standard approach is to maintain a constant heparinized flush through all long sheaths with access to the LA [1]. For patients who have been therapeutically anticoagulated with warfarin or direct oral anticoagulants (DOACs), ablation procedure performance without interruption of anticoagulation is the best strategy to avoid thrombotic complication (Class I recommendation). The recently published RE-CIRCUIT study reinforces the strategy of AF ablation on patients receiving uninterrupted anticoagulation. This trial showed a lower incidence of bleeding complications in patients managed with dabigatran as opposed to warfarin both during ablation and 8 weeks postablation [11]. Two other trials reinforce the safety of uninterrupted rivaroxaban (VENTURE-AF) or apixaban (AXAFA-AFNET 5) for catheter ablation in non-valvular AF [12, 13]. However, consensus determines is still reasonable to hold oral anticoagulation prior to AF ablation, with reinitiation postablation (Class IIa recommendation), considering the limited access to DOAC reversal agents and surgical backup facilities [1]. In the present case, despite a bolus of heparin before transeptal catheterization, the ACT of 280 s was a predisposing factor for thrombus formation. A strategy of weight-based bolus (100 IU/Kg body weight) is currently better and would probably decrease the risk of thrombus formation and potentially avoid the mentioned complication. Although we considered performing PVI under rivaroxaban, the lack of reversal agents raised concerns about safety. In our point of view, data from the NOAC Trials and the development of NOAC antidotes certainly should change future standards.

Regarding thrombus management, most authors described the technique of sheath aspiration while withdrawing catheters from the LA as successful [7, 8]. Intra-atrial thrombolysis with alteplase was also reported [14]. In the present case, thrombus migration while preparing for aspiration raised concerns of stroke. Since the patient was under general anesthesia, few parameters were available to rule out this possibility. The BIS is an electroencephalogram-based monitor approved for monitoring anesthetic depth. It uses a proprietary algorithm to convert a single channel of frontal EEG into an index of hypnotic level, ranging from 100 (awake) to 0 (isoelectric EEG). Specific ranges of 40 to 60 are recommended to reduce the risk of consciousness during general anesthesia. A sudden decline in the BIS score can be indicative of several causes, including administration of anesthetic drugs and embolic causes, such as stroke. Some reports have shown that a sharp decrease in BIS parameters can be associated with cerebral ischemia and hypoperfusion, although the BIS accuracy for stroke diagnosis is debatable [15].

Considering the lack of consensus in using BIS for diagnosing stroke, we reverted general anesthesia and performed a neurological evaluation and short-time period of clinical monitoring that was considered normal. The procedure was then resumed without further complications, with all four PVI having been isolated (Figure 2C). Post-procedure MRI confirmed no signs of cerebral or abdominal embolization. There were also no signs of clinical embolism. This benign course, despite sudden thrombus disappearance, favors the hypothesis of clot dissolution.

To the best of our knowledge, this is the first case report of temporary general anesthesia reversion after LA thrombus migration to rule out stroke. Although one may question the accuracy to rule out stroke using neurologic evaluation and BIS, financial concerns regarding the use of the Carto 3 system in our country compelled us to an alternative approach. As such, the evidence of a completely normal neurological examination associated with normal cerebral activity under BIS seemed acceptable. Considering the small window for thrombolysis in acute stroke, it is fundamental to carefully monitor patients during AF ablation procedures. As demonstrated in this case report, ICE monitoring for potential thrombus formation and other mechanical complications in the perioperative period is very important.

CONCLUSION

The placement of electrophysiology catheters in the left heart can predispose to early and late thrombus formation. Correct anticoagulation during the procedure is essential, as well as the continuous monitoring of thrombus formation. In this setting, the
use of ICE is extremely important. In case of thrombus in the catheters and sheaths, prompt aspiration while withdrawing the system seems to be the most common strategy. In case of thrombus dislodgment, all resources should be implemented to rule out stroke and peripheral embolization before continuing the ablation.

REFERENCES


Author Contributions
Diego Chemello – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published
Luana Quintana Marquesan – Substantial contributions to conception and design, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Guarantor of Submission
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Written informed consent was obtained from the patient for publication of this case report.

Conflict of Interest
Authors declare no conflict of interest.

Data Availability
All relevant data are within the paper and its Supporting Information files.

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