Journal of Cardiology Cases 29 (2024) 63–66

Contents lists available at ScienceDirect

Journal of Cardiology Cases

journal homepage: www.elsevier.com/locate/jccase

Case Report

Successful transvenous retrieval of an electrode ring dislodged from a novel visualized steerable sheath by inflation of a balloon inside the ring

Yuhei Kasai (MD) [a,*], Takuya Haraguchi (MD) [a], Takayuki Kitai (MD) [a], Junji Morita (MD) [a], Masanaga Tsujimoto (MD) [a], Jungo Kasai (PhD) [b], Tsutomu Fujita (MD) [a]

[a] Department of Cardiovascular Medicine, Sapporo Cardiovascular Clinic, Sapporo, Japan
[b] Toyota Technological Institute at Chicago, Chicago, IL, USA

ARTICLE INFO

Article history:
Received 22 May 2023
Received in revised form 15 September 2023
Accepted 11 October 2023

Keywords:
Electrode ring
Visualized steerable sheath
Percutaneous transvenous retrieval
Catheter ablation

ABSTRACT

The VIZIGO sheath (Biosense Webster, Irvine, CA, USA) is used for catheter ablation (CA) of atrial arrhythmia. In this case report, we describe a complication associated with the VIZIGO sheath and present a successful bailout method. An 82-year-old woman with paroxysmal atrial fibrillation (AF) and atrial tachycardia (AT) was referred to our hospital after experiencing palpitations for 6 months. She underwent CA using the VIZIGO sheath and a fixed Swartz sheath (St. Jude Inc., St. Paul, MN, USA). Pulmonary vein isolation and left atrial posterior wall isolation were performed to address AF and AT. Following ablation, the Swartz sheath was removed; however, the VIZIGO sheath showed resistance to removal. A wire was inserted into the VIZIGO sheath for removal, but the distal electrode ring detached in the vessel. To retrieve the electrode ring, a Mustang over-the-wire angioplasty balloon was dilated inside the ring and withdrawn with the ring. After venography and confirmation of a hemostatic seal, the ablation procedure was completed. The patient experienced postoperative anemia, which was resolved by erythrocyte transfusion. No further paroxysmal AF or AT occurred during the 1-year follow-up. In conclusion, the VIZIGO sheath's distal electrode ring may become detached during CA, and the detached ring can be successfully retrieved using our original bailout technique.

Learning objective: This case report highlights the unique complication of electrode ring detachment associated with the novel visualized steerable sheath (VIZIGO; Biosense Webster, Irvine, CA, USA) during catheter ablation procedures and presents the successful technique as a bailout method for retrieving the dislodged ring. The technique involves dilating a non-compliant over-the-wire angioplasty balloon inside the ring and withdrawing it along with the detached ring.

Introduction

Catheter ablation has become widely accepted as a standard treatment for atrial arrhythmia [1]. Studies have demonstrated that use of steerable sheaths during ablation procedures can enhance the safety and efficacy outcomes compared with use of conventional non-steerable sheaths [2]. Moreover, use of a novel bidirectional steerable sheath (VIZIGO; Biosense Webster, Irvine, CA, USA) that allows real-time visualization within a 3D electroanatomical mapping system has made it possible to reduce the fluoroscopic time required during the procedures [3]. Therefore, the use of this visualized steerable sheath in catheter ablation procedures has been increasing.

The present case report describes a complication unique to the visualized steerable sheath, namely retention of an electrode ring within the right common femoral vein (CFV), and our bailout method for this complication.

Case report

All procedures were performed in accordance with the ethical standards of the institutional and/or national research committees and the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

An 82-year-old woman was referred to our hospital for treatment of paroxysmal atrial fibrillation (AF) and atrial tachycardia (AT). She had a history of mitral valve plasty for mitral regurgitation following a mitral valve prolapse 18 years previously. The frequency of palpitations due to paroxysmal AF and AT had increased from 6 months before the referral. After providing informed consent, she underwent catheter ablation for paroxysmal AF and AT.

* Corresponding author at: Department of Cardiovascular Medicine, Sapporo Cardiovascular Clinic, North 49, East 16, 8-1, Higashi Ward, Sapporo, Hokkaido 007-0849, Japan.
E-mail address: yuheikasai_1025@yahoo.co.jp (Y. Kasai).

https://doi.org/10.1016/j.jccase.2023.10.007

At the beginning of the procedure, an 8.5-Fr visualized steerable sheath (VIZIGO) and an 8.5-Fr fixed sheath (Swartz; St. Jude Inc., St. Paul, MN, USA) were inserted from the right CFV (Fig. 1a). Pulmonary vein isolation and left atrium (LA) posterior wall isolation were performed for the AF and LA roof-dependent AT. After completion of the catheter ablation, the Swartz sheath was successfully removed without any issues. However, during the attempted removal of the VIZIGO sheath, resistance was encountered when the distal electrode ring was at the right external iliac vein (EIV) and subsequently CFV. The sheath could not be extracted further when the ring was at the CFV.

Venography performed using the VIZIGO sheath revealed bleeding from the right EIV (Fig. 1b). Therefore, the left CFV was punctured and a 6-Fr guiding sheath (CROSSROADS 45 cm; Nipro, Osaka, Japan) was inserted. A Jupiter FC™ 0.014-inch guidewire (Boston Scientific, Marlborough, MA, USA) was crossed to the right superficial femoral vein, and the EIV was dilated with a 6.0 × 40-mm balloon (SHIDEN HP®; Kaneka, Tokyo, Japan) for 10 min for hemostasis. Subsequently, the guiding sheath was advanced just proximal to the visualized steerable sheath. A 0.035-inch wire was advanced into the visualized steerable sheath, and re-extraction with different angles was attempted with no success. We then attempted to remove the visualized steerable sheath while inflating a 6.0 × 40-mm balloon (SHIDEN HP®) in the CFV (Fig. 1c). However, the distal electrode ring of the sheath became dislodged and remained inside the vessel (Fig. 1d, Fig. 2a, Video 1). Therefore, we dilated a 4.0 × 40-mm Mustang® over-the-wire angioplasty balloon (Boston Scientific) compatible with the 0.035-inch guidewire inside the electrode ring and were able to successfully remove the electrode ring (Fig. 1e, Video 2). Subsequent venography revealed that the right EIV had not been hemostatically sealed (Fig. 1f).

After appropriate vessel size evaluation by observation with an intravascular ultrasound system (Visions PV®; Termo, Tokyo, Japan) (Fig. 1g), hemostasis was performed by inflating a 7.0 × 60-mm balloon (Sterling®; Boston Scientific) in the right EIV for 30 min (Fig. 1g). Hemostasis of the EIV was confirmed on the final angiography (Fig. 1h) and the procedure was concluded. Following the procedure, blood laboratory tests revealed progressive anemia with a decrease in the hemoglobin concentration from 11.4 to 8.7 g/dL. Consequently, the patient received a transfusion of 4 units of red blood cells. No further progression of anemia was observed, and the patient was discharged after 1 week. During follow-up for 1 year, the patient remained free of AT and AF and had no related vascular complications.

Discussion

Previous reports have indicated that percutaneous endovascular retrieval of fractured sheaths or catheters is an important procedure that can prevent serious complications such as embolization, infection, and vessel perforation [4]. Various techniques for percutaneous removal of intravascular foreign bodies have been reported, including the use of snares and balloons [5,6]. In the present report, we have described the first case with retrieval of a dislodged electrode ring from a VIZIGO visualized steerable sheath, a specialized type of sheath used in catheter ablation procedures.

Our bailout method was based on the balloon-assisted strategy for percutaneous retrieval of fractured sheaths or catheters [7,8]. The technique relies on the wire passing through the ring (done before Fig. 1c). If resistance is encountered during sheath removal, it is recommended to withdraw the sheath with the wire inside to confirm that the wire has passed through the sheath.

Hereafter, we discuss the balloon utilized in our bailout technique. As the outer diameter of the VIZIGO sheath is 11.5 Fr, a 4-mm balloon was utilized. We thus believe that vascular damage is not particularly severe.

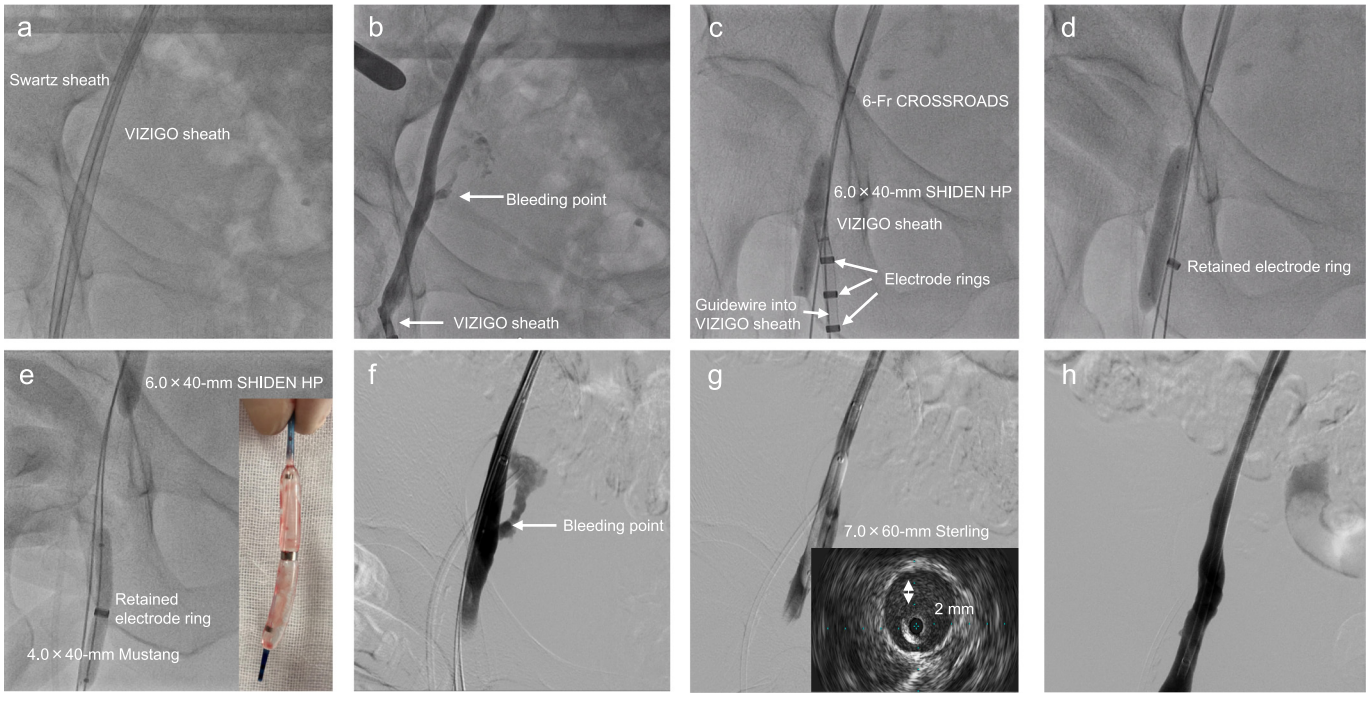

Fig. 1. (a) A VIZIGO sheath and a Swartz sheath were inserted from the right common femoral vein (CFV). (b) Venography image from the VIZIGO sheath. The distal electrode ring of the VIZIGO sheath was caught at the CFV. Venography was performed from the VIZIGO sheath. (c) During inflation of a 6.0 × 40-mm SHIDEN HP balloon outside the VIZIGO sheath in the CFV, an attempt was made to remove the VIZIGO sheath. This avoids the risk of the distal electrode ring migrating into the right atrium, right ventricle, or pulmonary artery by the pre-dilatation. Pre-dilatation could have strengthened the attachment of the ring or damaged the ring instead. (d) The distal electrode ring of the sheath became dislodged and remained inside the vessel. Ring dislodgement happened after pulling the VIZIGO sheath with pre-dilatation outside the VIZIGO sheath. (e) A 6.0 × 40-mm SHIDEN HP balloon was moved into the external iliac vein and expanded for hemostasis. A 4.0 × 40-mm Mustang balloon was dilated inside the dislodged electrode ring. This bailout method is illustrated in the image in the bottom right corner. (f) Venography image from the 6-Fr guiding sheath. Bleeding looks more severe than panel b, probably because the image is taken closer to the bleeding point. (g) After evaluation by intravascular ultrasound, a 7.0 × 60-mm Sterling balloon was expanded for hemostasis. (h) Final angiography image.

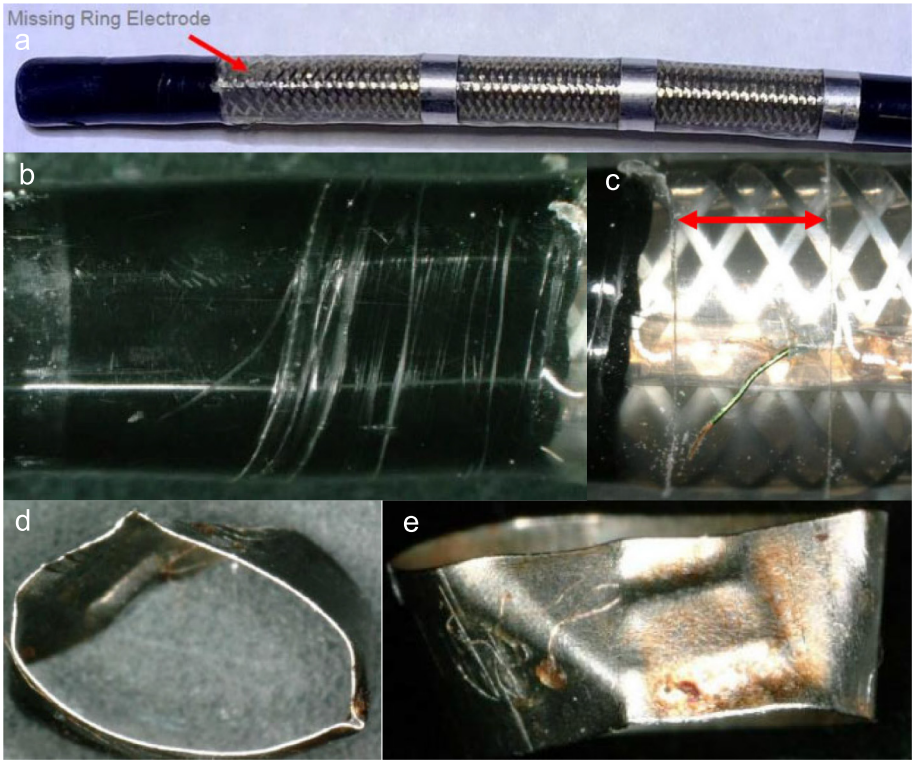

Fig. 2. (a) The removed VIZIGO sheath after the distal electrode ring had been dislodged. (b) Magnified image of the distal shaft of the VIZIGO sheath. (c) Magnified image of the outer layer of the shaft showing the attachment site of the dislodged electrode (red double-headed arrow). (d) Image of the dislodged electrode ring from the front. (e) Image of the dislodged electrode ring from the side.

We would have performed surgical removal if this technique had not worked. When performing the technique, use of non-compliant balloons (NCBs) is recommended overuse of semi-compliant balloons (SCBs). The compliance of a balloon device is defined as the increase in diameter that occurs with an increase in the designated inflation pressure [9]. SCBs initially increase in diameter at or near the more resistant portions in response to an increase in inflation pressure, and gradually assume a characteristic dumbbell shape with increasing pressure. In contrast, NCBs expand uniformly in the longitudinal direction and generally cannot exceed a certain maximum diameter. Therefore, NCBs are more suitable for our bailout technique because they can provide more predictable and stable deformation during inflation compared with SCBs [10].

We confirmed the presence of abrasions on the distal shaft of the VIZIGO sheath (black component on the left side in Fig. 2b) that were caused by the dislodged electrode ring. It is possible that the shaft became damaged when the dislodged electrode ring slid distally and applied stress to the shaft. As the damage occurred on the distal shaft of the electrode ring, rather than the proximal shaft, the abrasions probably arose during removal rather than during insertion. When the outer layer of the shaft was observed at the attachment site of the dislodged electrode ring (Fig. 2c), traces of appropriate adhesive processing during electrode ring and shaft bonding were confirmed.

We suspect there are two causes of the difficulty in removal of the sheath. First, the diameter of the EIV was narrow (as can be seen in Fig. 1b). Moreover, considering the resistance when pulling the sheath at the EIV, we suspect that the ring was a little loose (caused by, for example, the wall of the blood vessel or the venous valve) and became further loose at that time. Forcefully removing the sheath in this situation led to the bleeding from the EIV.

Note that we did not find any difficulty in puncture and thus did not perform ultrasound-guided femoral vein puncture. We also note that the SL-0 sheath was successfully removed before the VIZIGO sheath removal, making it difficult for us to predict the complications before insertion. Nonetheless, based on our case, we recommend that clinicians make use of a contrast agent and ultrasound to measure the diameters of the EIV and CFV, respectively.

Regarding the dislodged electrode ring, we observed deformities and damage such as indentations and bends (Fig. 2d, e), which may have arisen during the dilatation of the balloon within the ring.

It is possible that the electrode ring became dislodged from the VIZIGO sheath in response to slight elongation of the outer layer of the shaft at the attachment site for the electrode ring, which may have occurred during pulling of the ring toward the proximal end while being caught on the patient's vascular wall or other structures. This could have led to continuous application of stress to the electrode ring, causing it to move along the shaft and eventually become detached. While dislodgement of an electrode ring is a specific complication for this type of visualized steerable sheath, it should be recognized as a possible complication, and operators should use the sheath with caution.

Conclusions

We have demonstrated that our bailout technique is an effective method for percutaneous retrieval of a dislodged electrode ring from a visualized steerable sheath during catheter ablation procedures.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jccase.2023.10.007.

Consent statement

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. The authors confirm that written consent for submission was obtained from the patient in line with COPE guidelines.

Declaration of competing interest

None.

Acknowledgments

We thank Alison Sherwin, PhD, from Edanz (https://jp.edanz.com/ac) for editing a draft of this manuscript.

References

[1] Calkins H, Hindricks G, Cappato R, Kim YH, Saad EB, Aguinaga L, et al. 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation. Europace 2018;20:e1-60.
[2] Santangeli P, Lin D. Catheter ablation of paroxysmal atrial fibrillation: have we achieved cure with pulmonary vein isolation? Methodist Debakey Cardiovasc J 2015;11:71–5.
[3] Fitzpatrick N, Mittal A, Galvin J, Jauvert G, Keaney J, Keelan E, et al. The impact of steerable sheath visualization during catheter ablation for atrial fibrillation. Europace 2023;25:1345–51.
[4] Schechter MA, O'Brien PJ, Cox MW. Retrieval of iatrogenic intravascular foreign bodies. J Vasc Surg 2013;57:276–81.
[5] Koseoglu K, Parildar M, Oran I, Memis A. Retrieval of intravascular foreign bodies with goose neck snare. Eur J Radiol 2004;49:281–5.
[6] Carroll MI, Ahanchi SS, Kim JH, Panneton JM. Endovascular foreignbody retrieval. J Vasc Surg 2013;57:459–63.
[7] Lee SN, Jo MS, Yoo KD. Percutaneous retrieval of a fractured dialysis catheter using a balloon. J Vasc Access 2017;18:e42–4.
[8] Doğduş M, Dindaş F, Türkyılmaz E, Dindar B, Tunçer B, Candan Ö. Successful percutaneous transvenous removal of a fractured port catheter via novel technique: balloon-supported retrieval. Anatol J Cardiol 2021;25:671–2.
[9] Safian RD, Hoffmann MA, Almany S, Kahn J, Reddy D, Marsalese D, et al. Comparison of coronary angioplasty with compliant and noncompliant balloons (the angioplasty compliance trial). Am J Cardiol 1995;76:518–20.
[10] Sathananthan J, Hensey M, Sellers S, Barlow AM, Chhatriwalla AK, Allen KB, et al. Performance of the TRUE dilatation balloon valvuloplasty catheter beyond rated burst pressure: a bench study. Catheter Cardiovasc Interv 2020;96:e187–95.