International Journal of Arrhythmia

CASE REPORT

Open Access

Duo-decapolar catheter entrapment in the Chiari network: successful extraction with the snare catheter

Kyung-Yeon Lee[1†], Tae-Min Rhee[1†], So-Ryoung Lee[1], Eue-Keun Choi[1,2*] and Seil Oh[1,2]

Abstract

Background The Chiari network (CN) is the net-like embryonic remnants of the right valve of the sinus venosus. Catheter entrapment by CN is a not uncommon complication during catheter manipulation inside the right atrium (RA).

Case presentation A 49-year-old man with atrial fibrillation was admitted for cryoablation. Transesophageal echocardiography revealed a prominent CN in the RA. Through the sheath placed in the right femoral vein, a diagnostic electrophysiologic duo-decapolar (DD) catheter (Livewire, St Jude Medical, St Paul, MN) was advanced. The catheter tip was knotted after multiple rotations in the RA to properly locate the DD catheter at the RA wall and coronary sinus (CS). Initial attempts to disentangle the folded catheter tip by traction and rotation maneuvers were unsuccessful. We inserted the large-bore sheath (Sentrant; Medtronic, 20 Fr) into the patient's left femoral vein and then, captured the folded catheter tip with the 20-mm circular snare catheter (Snare Kit, Medtronic, Minneapolis, MN). Then, we cut the proximal portion of the DD catheter externally and removed it retrogradely through the Flexcath sheath. We found that the catheter tip was entrapped by the fibrous tissue of the CN. After a successful retrieval, cryoablation was conducted as planned. Follow-up echocardiography did not reveal any peri-procedural complications.

Conclusions The electrophysiological procedure that exists at the RA entails a potential risk of catheter entrapment manipulating the catheter at the RA. If catheter entrapment occurs during the procedure, the entrapped catheter may be removed via a large-bore sheath using a snare catheter.

Keywords Chiari network, Catheter entrapment, Snare catheter, Atrial fibrillation, Cryoablation

Background

The Chiari network (CN) is a net-like embryonic remnant and a congenital anatomical variation of the right valve of the sinus venosus in the right atrium [1, 2], which is present in approximately 2% of the general population [3]. CN may be incidentally identified perioperatively or during diagnostic imaging tests, such as transthoracic echocardiography (TTE), computed tomography, and magnetic resonance imaging. CN may also be linked to a higher occurrence of other congenital disabilities such as patent foramen ovale and atrial septal aneurysm [3, 4]. CN is usually considered clinically insignificant; however, it is reportedly associated with arrhythmia, endocarditis,

†Kyung-Yeon Lee and Tae-Min Rhee have contributed equally to this work.

*Correspondence:
Eue-Keun Choi
choiek17@snu.ac.kr
[1] Division of Cardiology, Department of Internal Medicine, Seoul National University Hospital, 101 Daehak-ro, Jongno-gu, Seoul 03080, Republic of Korea
[2] Department of Internal Medicine, Seoul National University College of Medicine, Seoul, Republic of Korea

thromboembolic disease, and catheter entrapment during percutaneous procedures [5]. If the CN exists in the right atrium (RA), manipulating the catheters during a procedure can be challenging and entails a risk of catheter entrapment by the CN. Herein, we report a case of accidental entrapment of a duo-decapolar (DD) catheter by a CN during cryoablation for atrial fibrillation (AF).

Case presentation

A 49-year-old man with persistent AF was admitted to our hospital for cryoablation. His medical history included heart failure with a preserved ejection fraction, diabetes mellitus, and thyroid hormone resistance syndrome. TTE showed normal ejection fraction, and transesophageal echocardiography demonstrated the presence of a prominent CN in the RA (Fig. 1A). After informed consent was obtained, an electrophysiological study was performed. A diagnostic electrophysiological DD catheter (Livewire, St Jude Medical, St Paul, MN, USA) was advanced through sheaths placed in the right femoral vein (Radifocus® Introducer Kit sheath, Terumo, 7Fr). We advanced the DD catheter into the RA to position it within the RA and coronary sinus (CS). While manipulating it inside the RA and rotating it multiple times in one direction to properly position the DD catheter at the RA wall and CS, the catheter tip subsequently became knotted. It was suspected that the catheter tip was entangled by the CN. Initially, we attempted to detach the catheter by traction and rotation. The catheter was successfully separated at the RA, but the catheter tip remained knotted. We attempted to disentangle the folded catheter tip using traction and rotation maneuvers, but these were unsuccessful. Next, we introduced a 20-mm circular snare catheter (Snare Kit, Medtronic, Minneapolis, MN, USA) via the left femoral vein sheath and captured the catheter's folded tip at the iliac vein bifurcation area. We attempted to disentangle the catheter by pulling the two catheters toward both femoral veins, but this did not work. We then inserted an additional sheath into the right internal jugular vein and advanced the snare catheter through the sheath. We captured the catheter's folded tip and attempted to unfurl it by pulling the two catheters in the opposite direction, but it was unsuccessful. Finally, we opted to employ a large-bore sheath (Sentrant; Medtronic, 20 Fr), which is typically used for the introduction of a leadless pacemaker, because the bore was sufficiently large to retrieve the entire folded catheter. We inserted the Sentrant introducer sheath into the patient's left femoral vein and then advanced the snare catheter (Fig. 1B). We captured the folded catheter tip in the iliac vein bifurcation region using a Snare Kit. We then cut the proximal portion of the DD catheter externally and removed it retrogradely through the entrant sheath placed in the left

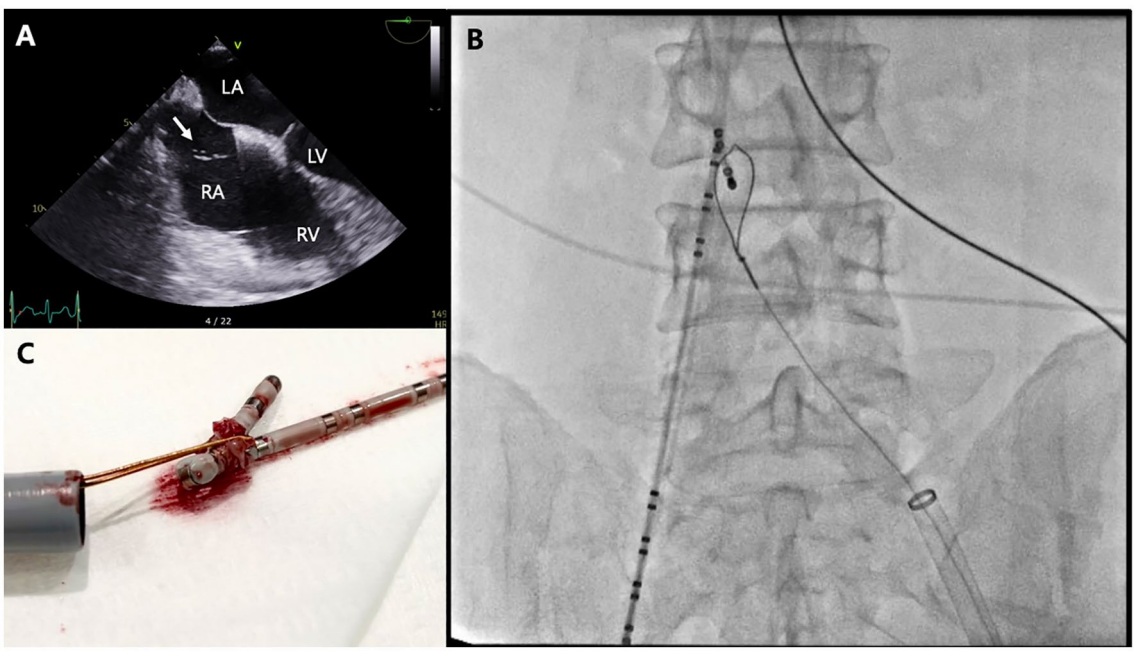

Fig. 1 **A** The preprocedural transesophageal echocardiography findings showed the Chiari's Network in the RA (arrow). **B** A fluoroscopic image during the procedure. The duo-decapolar catheter tip folded by the Chiari's Network was captured at the iliac vein bifurcation area and successfully extracted by the 20-mm circular snare catheter (Snare Kit; Medtronic, Minneapolis, MN). **C** A photograph of the retrieved duo-decapolar catheter. Entangled fibrous tissue of the Chiari network is seen

femoral vein (Additional file 1: Movie S1). We found that the catheter tip was entrapped in the fibrous tissue of the CN (Fig. 1C). After successful retrieval, cryoablation was performed as planned. Follow-up echocardiography on the procedural day revealed no acute procedural complications, including pericardial effusion, and the CN at the RA disappeared.

Discussion and conclusions

The net-like anatomical structure in the RA now known as the CN was first reported in 1875 and was given its name, the CN, in 1897 [6]. CN is an embryonic remnant that develops due to incomplete reabsorption of the right sinus venosus valve [5, 6]. CN is generally accepted as an insignificant structure, but it is clinically important because it may be a source of thrombi and is associated with other congenital disabilities, ischemic stroke, cardiac arrhythmias, and procedural complications [5]. Furthermore, as various electrophysiological procedures are needed to manipulate catheters in the RA, the risk of catheter entrapment by the CN may not be negligible [7].

Our case demonstrates that the DD catheter was knotted by the CN, and careful instrument handling within the RA is essential in patients with a significant CN. We have described the process of the DD catheter being knotted by the CN and its subsequent removal. We have emphasized that careful instrument handling within the RA is essential in patients with a significant CN. This is the first report describing the successful percutaneous retrieval of an electrophysiologic DD catheter entrapped by the CN through a large-bore sheath using a snare catheter. Because the diameter of the diagnostic catheter usually used during electrophysiology tests was less than 6Fr, it is sufficient to remove the knotted catheter through a 20Fr large-bore sheath. Using a large-bore sheath to remove the knotted catheter is considered a safe approach as it minimizes the risk of possible vessel injury from forcibly manipulating the folded catheter within the vein. Also, this method could avoid open heart surgery and related complications. One thing to note is that when cutting the proximal part of the catheter, it is important to ensure the cut area is not too sharp. It is because the sharp cut area could injure the vessel during the retrograde retrieval of the catheter.

Several studies have reported cases of catheter entrapment by the CN during procedures and approaches for retrieving the entangled catheter. A case of D-curve PentaRay mapping catheter entrapment by the CN during ablation of frequent premature ventricular contractions has been reported [1]. The authors of that report used a PentaRay mapping catheter, which was entrapped immediately after advancing through the inferior vena cava. They successfully retracted the PentaRay using traction and rotation movements supported by the sheath. Another case of DD catheter entrapment during AF ablation while positioning the catheter in the CS has been reported [8]. They removed the DD catheter using a lead extender commonly used to extract the pacemaker and defibrillator leads. Sakamoto et al. reported a case of multiloop intracardiac catheter entrapment during mapping for supraventricular tachycardia in RA [9]. They exfoliated CN tissue encircling the catheter tip using endomyocardial biopsy forceps and pulled the catheter forcefully, and then, the catheter was extracted by the CN. Nagahama et al. reported a case of DD catheter entrapment during ablation for atrial flutter [10]. The catheter was entrapped by the CN during attempts to position it around the tricuspid valve annulus. The catheter was released by applying radiofrequency energy for 10 s, a power of 30 W, and a temperature of 50 °C at the entrapment site. If these methods fail, the patient must undergo surgery under general anesthesia. Surgical removal of an atrial pacemaker lead entrapped by a CN has been previously reported [11]. The authors of that earlier report tried to remove the lead by pulling it and using a gooseneck snare for 3 h, but failed, ultimately necessitating surgical removal.

To prevent catheter entrapment by CN, getting detailed preprocedural images before intervention is important. TTE is one of the useful diagnostic tools for identifying CN in RA. If a prominent CN exists at the RA in preprocedural TTE, cautious manipulation of catheters inside the RA is necessary to prevent catheter entrapment by the CN. Furthermore, using separate mapping catheters and guidewire with a straight tip during the procedure may help prevent entrapment in the CN. Nevertheless, if catheter entanglement by the CN is suspected, try cautiously rotating the catheter in the opposite direction of the previous rotation initially. If the catheter does not disentangle, gentle traction and rotational maneuvers can be attempted. Moreover, if these methods are unsuccessful, removal of the entrapped catheter via a large-bore sheath using a snare catheter may be considered.

Abbreviations

CN	Chiari network
TTE	Transthoracic echocardiography
AF	Atrial fibrillation
RA	Right atrium
DD	Duo-decapolar
CS	Coronary sinus

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s42444-023-00100-7.

Additional file 1: Movie S1. Fluoroscopy showed that the folded catheter was captured by Snare catheter in the iliac vein bifurcation region and was removed retrogradely through the 20-Fr large bore sheath placed in the left femoral vein.

Author contributions

KYL was involved in managing the data, writing the initial draft, and reviewing and editing the manuscript. TMR contributed to conceptualizing, collecting the patient's clinical data, and reviewing and editing the manuscript. SRL and SO contributed to conceptualization and reviewing the manuscript. EKC was responsible for the patient's evaluation and provided conceptualization and supervision. The final approval for submission of the manuscript was granted by EKC. All authors have read and approved the final version of the manuscript.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

All data generated are anonymized.

Competing interests

The authors declare that they have no competing interests.

Received: 14 April 2023 Accepted: 30 June 2023
Published online: 01 August 2023

References

1. Quininir L, Luk PP, McGuire MA. Catheter entrapment in the Chiari network during catheter ablation. HeartRhythm Case Rep. 2020;6(12):896–8.
2. Patel N, Mariner D, Vijayaraman P. Successful percutaneous extraction of a circular mapping catheter entrapped in a Chiari network. J Interv Card Electrophysiol. 2021;62(1):213–4.
3. Orbison JL. Thrombosis of anomalous chordae in the right atrium; Chiari's network. Am Heart J. 1949;37(1):119–22.
4. Schneider B, Hofmann T, Justen MH, Meinertz T. Chiari's network: normal anatomic variant or risk factor for arterial embolic events? J Am Coll Cardiol. 1995;26(1):203–10.
5. Loukas M, Sullivan A, Tubbs RS, Weinhaus AJ, Derderian T, Hanna M. Chiari's network: review of the literature. Surg Radiol Anat. 2010;32(10):895–901.
6. Chiari H. Ueber netzbildungen im rechten vorhofe des herzens. Beitr Pathol Anat. 1897;22:1–10.
7. Ali H, Lupo P, Cristiano E, Nicolì L, Foresti S, De Ambroggi G, et al. Chiari network for the interventional cardiologist: a hidden enemy at the heart gate—a systematic review of the literature. Int J Cardiol. 2023;375:23–8.
8. Chu S, Solheim E, Chen J, Hoff PI, Schuster P. Entrapment and retrieval of a diagnostic electrophysiological catheter in the Chiari network. J Arrhythm. 2018;34(6):647–9.
9. Sakamoto A, Urushida T, Sakakibara T, Sano M, Suwa K, Saitoh T, et al. Accidental entrapment of electrical mapping catheter by Chiari's network in right atrium during catheter ablation procedure. Case Rep Cardiol. 2016;2016:1302473.
10. Nagahama MV, Sakai MH, Souto MCX, Frota ESD, Cirenza C, de Paola AAV. Catheter entrapment in Chiari network: extraction with radiofrequency. Indian Pacing Electrophysiol J. 2019;19(5):195–6.
11. Sakai T, Sato Y, Kawasaki T, Takahashi H. Surgical removal of a pacemaker lead entrapped by a Chiari network: a case report. J Med Cases. 2021;12(8):325–7.

Publisher's Note