Right coronary artery wall edema provoked by cavotricuspid isthmus radiofrequency ablation

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Introduction
Acute coronary stenosis has been reported as a rare but potentially serious complication of cavotricuspid isthmus (CTI) ablation. Various causes of the stenosis have been reported (thrombus, coronary spasm), but cause is often unknown. Most of the cases receive coronary intervention regardless of the cause. We present a case of “temporary edema” of the coronary artery wall provoked by CTI radiofrequency (RF) ablation.

Case report
A 67-year-old man underwent catheter ablation of drug-resistant paroxysmal atrial fibrillation and typical atrial flutter. The preoperative cardiac computed tomography showed a 25% stenosis of the atrioventricular (AV) nodal artery (AVna), which branched from the right coronary artery (RCA). Pulmonary vein isolation was successfully completed without any adverse events. After withdrawal of all catheters from the left atrium, CTI ablation was performed by RF ablation with a 3.5-mm-tip irrigated catheter (SmartTouch ThermoCool, Biosense Webster, Diamond Bar, CA). The power was restricted to 35 W with the irrigation flow rate titrated to maintain a target temperature under 45°C.

Eight seconds after the initial ablation was started along the CTI line, the ST segment suddenly became elevated in the inferior leads (II, III and aVF) and 2:1 AV block occurred following Wenckebach-type AV block (Figure 1, Figure 2A). The RF application was halted immediately and the 2:1 AV block subsided, but not the ST elevation. The temperature had risen from 32°C to 45°C and the impedance had dropped from 166 ohms to 133 ohms in the 8 seconds. Emergency

Figure 1 Eight seconds after the initial ablation was started at the cavotricuspid isthmus line, ST-segment elevation in inferior leads and 2:1 atrioventricular block (AVB) suddenly occurred following Wenckebach-type AVB. Abl = ablation catheter; CS = coronary sinus; TA = tricuspid annulus.

KEYWORDS
Common atrial flutter; Cavotricuspid isthmus; Catheter ablation; Coronary artery stenosis; Optical frequency-domain imaging (Heart Rhythm Case Reports 2017;3:443–446)

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coronary angiography (CAG) showed that the AVna stenosis had advanced to 99% (TIMI class II) (Figure 2B) and was not ameliorated by injection of isosorbide dinitrate into the RCA. The follow-up CAG the next day showed that the stenosis had improved somewhat to TIMI class III. Optical frequency-domain imaging (OFDI) showed that the vessel wall protruded into the coronary artery lumen at the site of narrowing. Swelling was eccentrically located and visualized as a low-signal mass next to the ablation site and had no attenuation. Angioplasty was not performed because the stenosis was improving on its own. Before the patient’s hospital discharge, we confirmed by a treadmill test that exercise did not induce cardiac ischemia. Five months after discharge, CAG and OFDI were performed again. The CAG showed that the narrowing of the AVna stenosis had returned to pre-ablation dimensions and the OFDI revealed that the swelling had completely subsided (Figure 3). We speculate that the RF energy application very close to the coronary artery had produced temporary edema that caused a localized severe narrowing of the vessel.

Discussion
To the best of our knowledge, this is the first report of RCA stenosis during CTI ablation assessed by OFDI over time and treated without coronary intervention. In this case, the follow-up OFDI images were powerful tools for diagnosing the cause of swelling in the RCA as edema owing to the RF energy.

There have been some case reports of RCA narrowing owing to CTI ablation1–5,7 and ensuing AV block.1 In these reports, the ablation catheters were almost all large-tip nonirrigated catheters and output was 65–100 W. In only 1 report coronary angiography (CAG) showed that the AVna stenosis had advanced to 99% (TIMI class II) (Figure 2B) and was not ameliorated by injection of isosorbide dinitrate into the RCA. The follow-up CAG the next day showed that the stenosis had improved somewhat to TIMI class III. Optical frequency-domain imaging (OFDI) showed that the vessel wall protruded into the coronary artery lumen at the site of narrowing. Swelling was eccentrically located and visualized as a low-signal mass next to the ablation site and had no attenuation. Angioplasty was not performed because the stenosis was improving on its own. Before the patient’s hospital discharge, we confirmed by a treadmill test that exercise did not induce cardiac ischemia. Five months after discharge, CAG and OFDI were performed again. The CAG showed that the narrowing of the AVna stenosis had returned to pre-ablation dimensions and the OFDI revealed that the swelling had completely subsided (Figure 3). We speculate that the RF energy application very close to the coronary artery had produced temporary edema that caused a localized severe narrowing of the vessel.

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Figure 2  A: The initial ablation point of the cavotricuspid isthmus ablation with a 3.5-mm-tip irrigated catheter. B: Coronary angiography showed that the atrioventricular nodal artery became 99% narrowed (white arrow). Cathe = catheter; CS = coronary sinus; LAO = left anterior oblique; RAO = right anterior oblique; TA = tricuspid annulus.
was an irrigated catheter used. There was a case report of the coronary flow being transiently and severely impaired during cryoablation at the CTI. Most of these cases underwent coronary intervention and no one has ever reported a stenosis that dissipated without treatment, as in our case. Moreover, previous reports did not describe the change of catheter-tip temperature and impedance during the procedure. We could show that the abrupt changes of catheter-tip temperature and impedance, which usually reflect excessive ablation of the myocardial tissue, had the possibility to affect neighboring coronary artery during CTI ablation in this report.

In previous reports of RCA narrowing owing to CTI ablation, the cause of injury was often stated as unknown, although in some reports CAG or autopsy confirmed that there were thrombi at the narrowed site. In our case, a thrombus was thought to be unlikely as the cause of the stenosis, based on the images produced by OFDI. OFDI and optical coherence tomography (OCT) are novel technologies that provide even higher-resolution imaging and near-microscopic details of objects in vessels than intravascular ultrasound. Two significant features of the OFDI images over time in this case were that the swelling in the RCA had a low signal and no attenuation during the acute phase and that it disappeared in the chronic phase. Furthermore, the intensity of the signal of the protrusion matched that of the normal vessel wall, distinguishing it from thrombus. These findings suggested that the nodule involved localized edema of the circumference of the vessel wall. Leo and colleagues reported a case of left circumflex coronary artery stenosis owing to RF ablation of a left-sided posteroseptal accessory pathway in a Wolff-Parkinson-White syndrome patient. The OCT image revealed localized swelling of the vessel wall similar to that in our patient. They concluded that the cause of the swelling was edema or vasospasm with a superimposed thrombus based on a single OCT image and performed an intervention.

Conclusion
In conclusion, this case suggests that acute stenotic lesions caused by RF catheter ablation may rarely be caused by transient edema and do not necessarily require intervention, although careful observation is necessary.

References
1. Yune S, Lee WJ, Hwang JW, Kim E, Ha JM, Kim JS. Acute myocardial infarction after radiofrequency catheter ablation of typical atrial flutter. J Korean Med Sci 2014;29:292–295.
2. Brembilla-Perrot B, Filali ML, Beurrier D, Groben L, Cedano J, Abdelaal A, Louis P, Claudon O, De La Chaise AT, Ethevenot G. Complete atrioventricular block during ablation of atrial flutter. Pacing Clin Electrophysiol 2010;33:516–519.
3. Mykytsey A, Kehoe R, Bharati S, Maheshwari P, Halleran S, Krishnan K, Razminia M, Mina A, Trohman RG. Right coronary artery occlusion during RF ablation of typical atrial flutter. J Cardiovasc Electrophysiol 2010;21:818–821.
4. Ouali S, Anschme F, Savoure A, Cribier A. Acute coronary occlusion during radiofrequency catheter ablation of typical atrial flutter. J Cardiovasc Electrophysiol 2002;13:1047–1049.
5. Sassone B, Leone O, Martinelli GN, Di Pasquale G. Acute myocardial infarction after radiofrequency catheter ablation of typical atrial flutter: histopathological findings and etiopathogenetic hypothesis. Ital Heart J 2004;5:403–407.
6. Caldwell JC, Fath-Odoubadi F, Garratt CJ. Right coronary artery damage during cavotricuspid isthmus ablation. Pacing Clin Electrophysiol 2010;33:e110–e113.
7. Raio N, Cohen TJ, Daggubati R, Marzo K. Acute right coronary artery occlusion following radiofrequency catheter ablation of atrial flutter. J Invasive Cardiol 2005;17:92–93.
8. Weiss C, Becker J, Hoffmann M, Willems S. Can radiofrequency current isthmus ablation damage the right coronary artery? Histopathological findings following the use of a long (8 mm) tip electrode. Pacing Clin Electrophysiol 2002;25:860–862.
9. Johansson BI, Hrafnkelsdottir TJ, Edvardsson N. ST segment elevation and chest pain during cryoablation of atrial flutter. Europace 2007;9:407–410.
10. Leo M, De Maria GL, Betts TR, Banning AP. Management and optical coherence tomography imaging of an acute coronary artery injury induced by radiofrequency catheter ablation. Int J Cardiol 2014;174:e44–e46.