https://doi.org/10.35336/VA-1352

ASYMPTOMATIC CORONARY-ATRIAL FISTULA FORMATION AFTER ZERO FLUORO CATHETER ABLATION FOR INCESSANT RIGHT ATRIAL TACHYCARDIA USING ABLATION INDEX MODULE: CASE REPORT

E.B.Kropotkin, E.A.Ivanitskiy, A.P.Tsaregorodtsev, A.A.Vyrva, V.A.Sakovich
FSBI "Federal Center of Cardiovascular Surgery" of the MH RF, Russia, Krasnoyarsk, 45 Karaulnaya str.

We present a case of asymptomatic coronary-atrial fistula formation after zero fluoro catheter ablation for incessant right atrial tachycardia using ABLATION INDEX module.

Key words: zero fluoro catheter ablation; radiofrequency ablation; coronary-atrial fistula; incessant atrial tachycardia; ablation index

Conflict of Interest: none.
Funding: none.
Received: 14.03.2024 **Revision received:** 01.08.2024 **Accepted:** 12.08.2024
Corresponding author: Evgeny Kropotkin, E-mail: kroj@inbox.ru

E.B.Kropotkin - ORCID ID 0000-0001-9094-378X, E.A.Ivanitskiy - ORCID ID 0000-0002-4946-8005, A.A.Vyrva - ORCID ID 0000-0002-6937-9544, V.A.Sakovich - ORCID ID 0000-0001-7743-8770

For citation: Kropotkin EB, Ivanitskiy EA, Tsaregorodtsev AP, Vyrva AA, Sakovich VA. Asymptomatic coronary-atrial fistula formation after zero fluoro catheter ablation for incessant right atrial tachycardia using ablation index module: case report. *Journal of Arrhythmology.* 2024;31(3): 59-63. https://doi.org/10.35336/VA-1352.

Postincisional tachycardias are a relatively common complication in patients who have undergone prior open-heart surgeries [1]. Radiofrequency catheter ablation (RFA) of supraventricular tachyarrhythmias (SVT) in this patient cohort is both a highly effective and safe technique, particularly when compared to pharmacological therapy. Direct coronary artery (CA) injury during radiofrequency catheter ablation (RFA) is an exceedingly rare event, with global experience limited to the documentation of isolated clinical cases [4-8]. Modern techniques for inducing radiofrequency myocardial injury with pressure force-controlled catheters are designed to achieve controlled exposure, thereby optimizing both efficacy and safety. However, it is not always possible to completely avoid adverse events during controlled RFA.

The aim of this work is to present a unique case of coronary-right atrial fistula formation following radiofrequency ablation using a SmartTouch pressure force monitoring catheter and the Ablation Index module (Biosense Webster, USA) near the right coronary artery.

A 75-year-old patient had undergone surgery for mitral stenosis 10 years prior, which involved the implantation of a biological mitral valve prosthesis via a left-sided minithoracotomy at a European center. Prior to the «open heart» surgery, diagnostic coronary angiography was performed as a standard procedure, and the coronary arteries were found to be unchanged.

On the first postoperative day, a sternotomy was performed to review the mediastinal organs and address bleeding, ensuring hemostasis. The surgical intervention was carried out under conditions of cardiopulmonary bypass. On the second postoperative day, the patient experienced paroxysms of atrial fibrillation (AF), which were managed with medication. For 6 years, the arrhythmia did not trouble the patient. Three years ago, a paroxysm of AF was recorded again; on the second day, the rhythm was restored with the administration of the class I antiarrhythmic drug propafenone. Three months later, a paroxysm of rhythmic palpitations occurred. Drug-induced cardioversion - no effect. ECG shows an atrial flutter (AFl) rhythm. RFA of atypical right atrial flutter was performed. Two

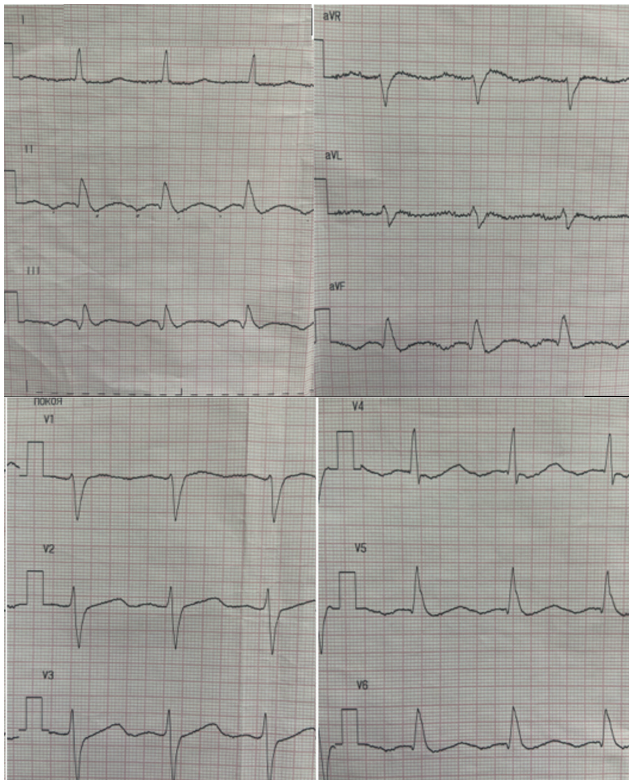

Fig. 1. ECG of a patient with atrial flutter.

years later, the arrhythmia recurred again: SVT with irregular conduction at the atrioventricular junction (Fig. 1).

A decision was made to perform repeat SVT RFA. Prior to the operation, the patient underwent diagnostic coronary angiography (Fig. 2), which revealed diffuse changes in the coronary arteries, hemodynamically insignificant stenoses of the anterior interventricular branch of the left coronary artery (30-40%), and the presence of a myocardial bridge of the left coronary artery. Nephluoroscopic (completely without fluoroscopy) catheter ablation was performed under CARTO 3 navigation system (Biosense Webster, USA), using SmartTouch pressure force control catheter (Biosense Webster, USA) and Ablation Index (AI) module (Biosense Webster, USA) (Fig. 3). After previously performed open heart surgery and RFA, a large area with low or no signal amplitude - scar-altered tissue - is visualized on the right atrium (RA) voltaic map (Fig. 3b). The activation map visualizes the circulation of a re-entry wave with a cycle of 270 ms on the lateral wall of the RA, where the critical isthmus is the area between the scar-altered tissue and the fibrous ring of the tricuspid valve. Electrophysiologic tests confirm the activation mapping data. It was decided to perform a linear impact on the free wall in order to create a block of impulse conduction along the critical isthmus (Figs. 3 c,d). Target AI values during ablation of 400-450 units were achieved at 50 W power. During ablation, restoration of sinus rhythm is noted with a slowing of the tachycardia cycle to 315 ms. No tachycardia is induced on control electrophysiologic study after 15 minutes of waiting time. The patient was discharged the next day in sinus rhythm.

Two years later, the patient again felt a characteristic rhythmic heartbeat and increasing dyspnea at minor physical activity and sought medical help. During the examination, a recurrence of tachycardia and dysfunction of the biological mitral valve prosthesis was diagnosed, presenting as the formation of mitral insufficiency. This was attributed to the dysfunction of one of the prosthetic flaps, characterized by a 0.4 cm tissue defect at the base of the flap adjacent to the aortic valve ring. Additionally, the flap exhibited areas of compaction. There was no evidence of a paraprosthetic fistula.

A decision was made to repeat SVT RFA. Given the presence of diffuse changes in the coronary arteries, hemodynamically insignificant stenoses of the anterior interventricular branch of the left coronary artery (up to 30-40%), and myocardial bridging detected two years earlier, routine coronary angiography was performed as part of the

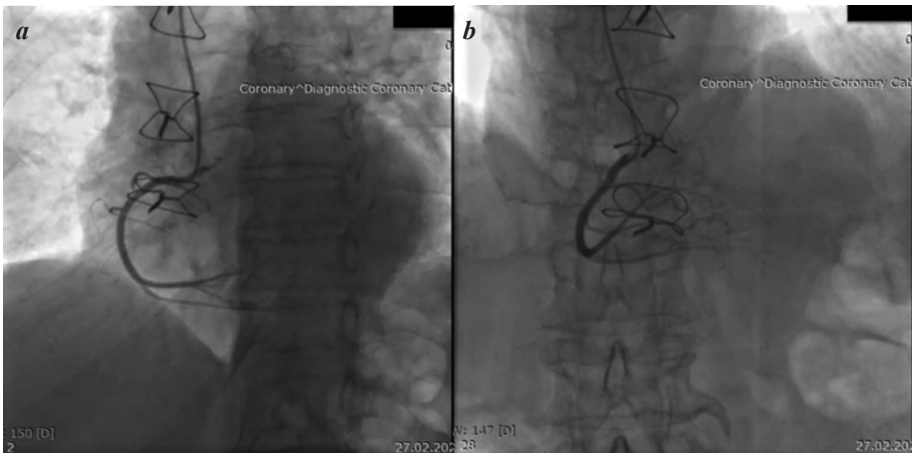

Fig. 2. Diagnostic coronarography of the right coronary artery: a - projection of LAO 20, CAU 2, b - projection of RAO 6, CRA - 28.

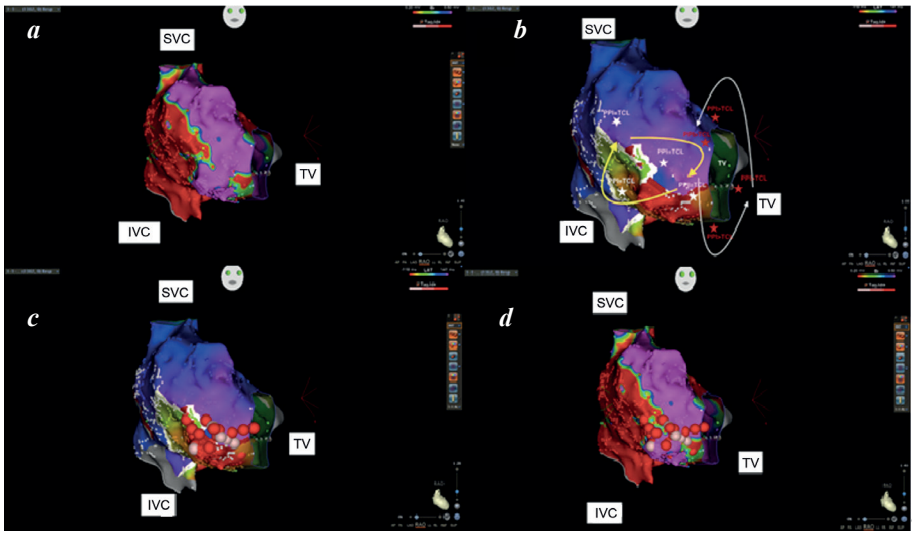

Fig. 3. Mapping of the right atrium (RA): a - voltage map of the RA after previously performed ablation procedure of atypical right atrial flutter; b - electroanatomic (activation) map of the RA; c - electroanatomic map showing linear influence on the free wall of the RA; d - voltage anatomic map showing linear influence on the free wall of the RA, hereinafter SVC - superior vena cava, IVC - inferior vena cava, TV - tricuspid valve.

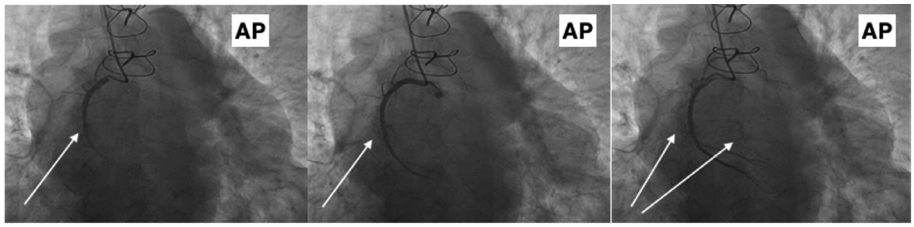

Fig. 4. A series of X-ray images with contrast of the right coronary artery in the direct projection, showing the «discharge» of contrast agent from the right coronary artery into the right atrium (indicated by arrows).

preoperative preparation. No significant negative changes were observed; however, selective contrast imaging of the right coronary artery in the middle third projection demonstrated «dumping» of the contrast agent into the right atrium. Thus, a coronary-atrial fistula was diagnosed (Fig. 4). The consilium decided on conservative management of the patient in relation to the «finding» considering the absence of clinical and echocardiographic changes.

The patient is taken to the operating room for SVT RFA. Nephluoroscopic catheter ablation was performed with the CARTO 3 navigation system (Biosense Webster, USA), SmartTouch pressure force control catheter (Biosense Webster, USA), PENTARAY high-density mapping catheter (Biosense Webster, USA), Ablation Index module (Biosense Webster, USA), and COHERENT module (Biosense Webster, USA) (Figs. a-c). Electroanatomic reconstruction of the RA revealed the circulation of the re-entry wave in the same location, but with a longer cycle of 292 ms.

Prior to nonfluoroscopic RFA, precautions were implemented, including catheterization of the left radial artery to monitor invasive blood pressure. This access route could also be utilized for potential interventional procedures on the coronary artery if necessary. A specialist from the Department of X-ray Surgical Methods of Diagnostics and Treatment, equipped with all necessary instruments, was present at the operating table. Given the presence of a slow conduction zone (as indicated by the COHERENT module during high-density mapping of the right atrium with the PENTARAY catheter) at 8 mm from the right atrioventricular ring, a decision was made to apply a minimal number of radiofrequency energy applications with a power of 40 W and target Ablation Index (AI) values of 450 units (Fig. 5c).

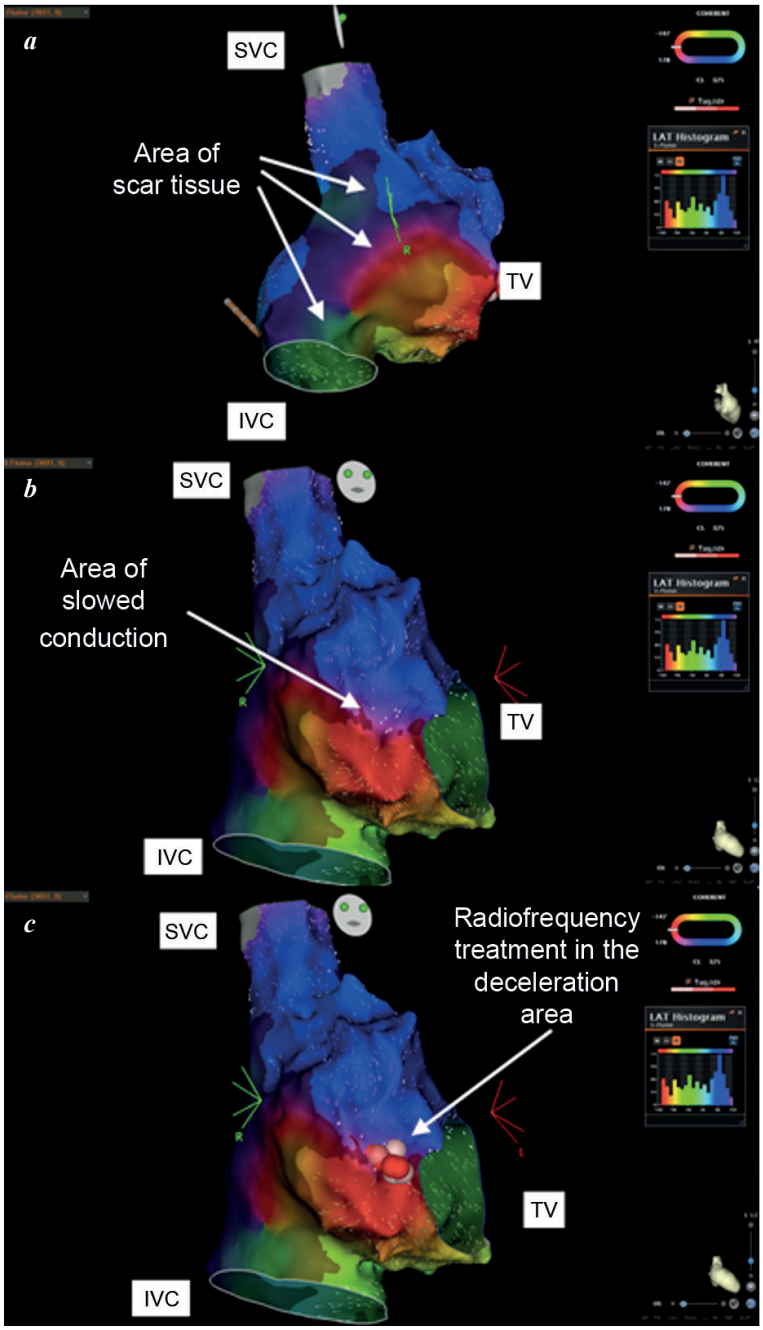

Fig. 5. Electroanatomical reconstruction of the right atrium using PENTARAY catheter and COHERENT module (a, b); electroanatomical map of the right atrium after radiofrequency interventions in the critical isthmus region, where impulse conduction slowing was detected (c).

On ablation, restoration of sinus rhythm is noted with a slowing of the tachycardia cycle to 342 ms. No ST segment changes in 12 leads were detected during ablation and during 40 minutes of follow-up. Clinically, no pain or discomfort behind the sternum was noted by the patient. It was decided to perform control coronary angiography only in case of negative dynamics in clinical status.

The series of ECG, Holter monitoring on the next day after surgery, echocardiography showed no negative dynamics. The patient was discharged a day after surgery in a satisfactory condition. During the follow-up period - 12 months - no paroxysms of tachycardia were recorded on ECG. Improvements in clinical status are noted in the form of decreased dyspnea and improved exercise tolerance. However, these manifestations have not been eliminated. This may be due to persistent dysfunction of the MV prosthesis.

DISCUSSION

Based on our findings, the occurrence of a coronary-atrial fistula during ablation in the right atrium using a catheter with tissue pressure force control and Ablation Index (AI) monitoring has not been previously reported in the world literature. The formation of coronary-atrial fistula in our case occurred after repeated RFA in RA using short-term high-power 50 W and Ablation Index module. Selective coronarography of the right coronary artery before the intervention showed no contrast agent discharge into the RA cavity.

The safe and effective use of such ablation parameters for performing linear exposures in the left atrium has been widely reported in the literature [2, 3]. Furthermore, in one of the initial studies utilizing the Abla-

tion Index module, the target AI values were significantly higher than those reported in this paper, reaching up to 550 units. Currently, there is no standardized set of AI values established for ablations across different atrial regions. Therefore, each clinic uses a «proprietary» standard. In our center, we use an approach of applying impacts with minimal AI to ensure transmural damage to the atrial wall. Moreover, short, high-power exposures may reduce the likelihood of collateral organ damage. Similar ablation parameters are routinely used in daily clinical practice in our center to perform wide antral pulmonary vein orifice isolation in the treatment of AF. The implementation of this approach did not result in an increased incidence of complications or serious adverse events when compared to the standard methodology.

Instances of right coronary artery stenosis formation have been reported during radiofrequency applications in the right atrium, such as in catheter ablation of typical atrial flutter [4-8]. Such complications may occasionally be attributed to anatomical peculiarities, including the subendocardial location of the right coronary artery or the reduced thickness of the myocardium above the artery in radiofrequency exposure. In some cases, it ended with stenting of the right CA. Moreover, in an animal experiment, it was shown that direct damage to the coronary artery and adjacent myocardium occurred in 8 out of 10 pigs [9]. On the other hand, Calkins et al, when performing RFA of typical AFl showed that the incidence of complications did not exceed 2.7%, and there was no mention of CA injury. In our case, the formation of asymptomatic right CA fistula occurred.

Further clinical studies are required to evaluate the efficacy and safety of radiofrequency intervention using a tissue pressure force-controlled catheter and Ablation Index module near the coronary arteries.

REFERENCES

1. fammatter JP, Wagner B, Berdat P, et al. Procedural factors associated with early postoperative arrhythmias after repair of congenital heart defects. 2002;123(2):258-62. https://doi.org/10.1067/mtc.2002.119701.

2. Chen S, Schmidt B, Bordignon S, et al. Ablation Index guided 50 Watts ablation for pulmonary vein isolation in patients with atrial fibrillation: procedural data, lesion analysis and initial results from the FAFA AI High Power Study. *J Cardiovasc Electrophysiol.* 2019;30(12): 2724-2731. https://doi.org/10.1111/jce.14219.

3. Berte B, Hilfiker G, Russi I, et al. Pulmonary vein isolation using a Higher Power Shorter Duration CLOSE protocol with a surround flow ablation catheter. *Journal of Cardiovasc Electrophysiol.* 2019;30(11): 2199-2204. https://doi.org/10.1111/jce.14122

4. Al Aloul B, Sirdudsson G, Adabag S, et al. Atrial Flutter Ablation and Risk of Right Coronary Artery Injury. *Journal of Clinical Medicine Research.* 7. 270-273. https://doi.org/10.14740/jocmr1986w.

5. Weiss C, Becker J, Hoffman M, et al. 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(5): 860-862. https://doi.org/10.1046/j.1460-9592.2002.00860.x.

6. Ouali S, Anselme F, Savoure A, et al. Acute coronary occlusion during radiofrequency catheter ablation of typical atrial flutter. *J Cardiovasc Electrophysiol.* 2002;13(10): 1047-1049. https://doi.org/10.1046/j.1540-8167.2002.01047.x.

7. Raio N, Cohen TJ, Daggubati R, et al. Acute right coronary artery occlusion following radiofrequency catheter ablation of atrial flutter. *J Invasive Cardiol.* 2005;17(2): 92-93.

8. Sassone B, Leone B, Martinelli GN, et al. Acute myocardial infarction after radiofrequency catheter ablation of typical atrial flutter: histopathological findings and etiopathogenic hypothesis. *Ital Heart J.* 2004;5(5): 403-407.

9. Paul T, Bokenkamp R, Mahnert B, et al. Coronary artery involvement early and late after radiofrequency current application in young pigs. *Am Heart J.* 1997;133(4): 436-440. https://doi.org/10.1016/s0002-8703(97)70185-6.