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CATHETER ABLATION OF ATRIAL TACHYCARDIA FROM THE NON-CORONARY VALSALVA SINUS

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A case report of atrial tachycardia ablation form the non-coronary Valsalva sinus is presented.

Key words: atrial tachycardia; interatrial septum; atrioventricular connection; non-coronary sinus of Valsalva; mapping; radiofrequency ablation

Conflict of Interests: nothing to declare
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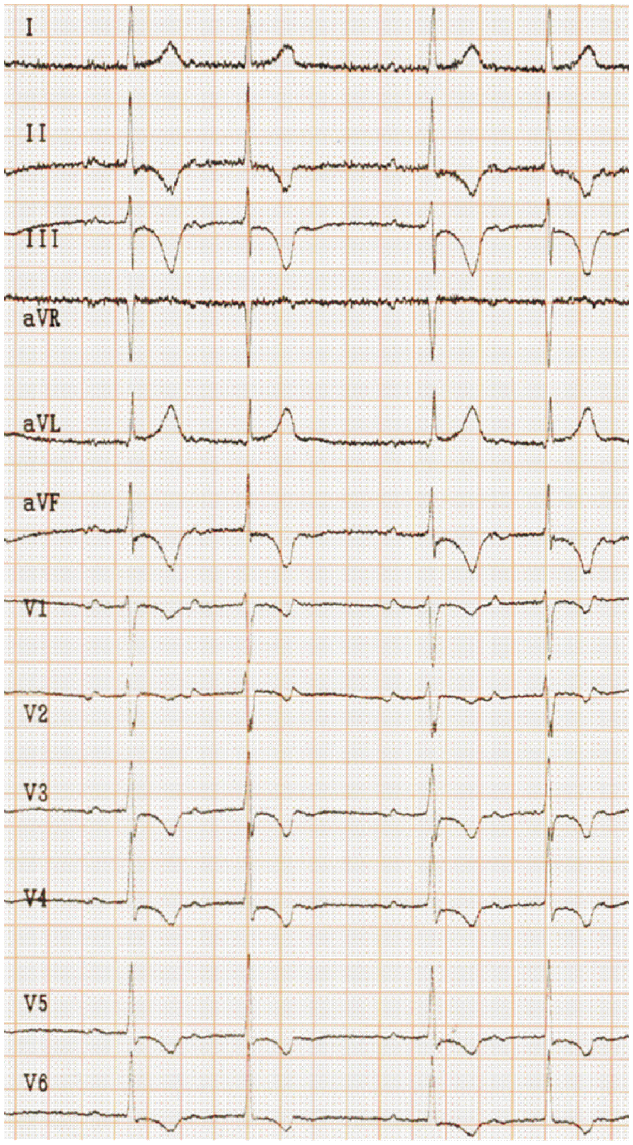

Fig .1. ECG of patient K. Sinus rhythm, frequent atrial premature beats in a bigeminal pattern.

Currently endocardial catheter ablation is the method of choice in the treatment of the most forms of cardiac arrhythmias, including the entire spectrum of supraventricular tachycardia. However, in the treatment of atrial tachycardia, its efficiency can vary widely [1], which is due to both the localization of the arrhythmogenic substrate and the difficulties of its mapping, as well as problems associated with the stability of the positioning of the ablation catheter, as well as the safety of exposure.

The localization of the substrate of atrial tachycardia is primarily associated with the following areas: crista terminalis, interatrial septum, annulus of mitral and tricuspid valves, right and left atrial appendage, ostium of pulmonary veins and coronary sinus (CS) ostium [2-8]. As a rule, in the most of these cases standard transvenous endocardial access is able to ensure success in determining the localization and ablation of the arrhythmia substrate with minimal risk of possible complications. However, for some patients, the standard approach does not guarantee the success and safety of treatment for arrhythmia. In particular, when it comes to the localization of the tachycardia substrate in the anterior region of the interatrial septum, where the anatomical proximity to the compact part of the atrioventricular (AV) joint makes it difficult to place optimally the ablation catheter, since radiofrequency (RF) exposure in this area has a high risk of disruption of AV conduction.

Peculiarities of atrial tachycardia arising from the anterior part of the atrial septum were widely discussed earlier [9-18, 22]. The main electrophysiological characteristics of this tachycardia were noted: easy induction and stopping of tachycardia after programmed stimulation of the heart, its start without previous ectopic activity in the atria, mapping of the earliest activation of tachycardia in the projection of the His bundle in the right atrium. It is possible to stop this type of tachycardia by intravenous administration of adenosine.

From January 2013 to July 2018, we operated 83 patients (mean age 47.3±16.5 years, 44 women) with atri-

al tachycardia. All procedures were performed using the navigation system CARTO-3, and in addition, cryoablation was done in 2 patients. The distribution of patients in accordance with the localization of the arrhythmogenic substrate was the following: in 32 patients (39%) the arrhythmia substrate was localized in the region of crista terminalis, in 19 (23%) in the left atrium, in 11 (13%) in the ostium of CS, in 6 (7%) in the area of cavotricuspid isthmus and in 16 patients (19%) in the area of interatrial septum. At the same time, in 8 patients ablation of the arrhythmia substrate was performed in more than one of these areas, for example, combined procedures were done in the region of crista terminalis and atrial septum, as well as in crista terminalis and cavotricuspid isthmus.

From 16 patients with the arrhythmia substrate originating from interatrial septum, 14 patients underwent successful RF ablation using the navigation system CARTO-3 and 2 patients underwent cryoablation of the arrhythmia substrate in the immediate vicinity of the His bundle. In all patients, the standard transvenous approach was used initially for mapping, additionally 3 patients required puncture of the interatrial septum for mapping from the left atrium.

In 3 patients from 16, the localization of the tachycardia substrate was verified in the anterior part of the interatrial septum (area of fast pathway of AV-conduction and His bundle) using activation mapping. Despite the accurate determination of the arrhythmia substrate location, RF ablation was nevertheless carried out in adjacent areas to reduce the risk of inadvertent AV-block. Due to the inefficiency or transient effect of RF ablation in these patients, we used transaortic access from the non-coronary sinus of Valsalva (SV). When mapping non-coronary SV, in all patients areas of even earlier activation of the arrhythmogenic substrate were verified (on average from 5 to 15 ms) compared to the data obtained by mapping from the right atrium. All 3 patients underwent successful ablation. Introducing the clinical observation of one of these patients.

A patient K., 47 years old, was admitted to the hospital with a diagnosis: Arterial hypertension stage II, degree 2, risk 3. Paroxysmal atrial tachycardia. Frequent atrial premature beats (APB) in a bigeminal pattern. Condition after two radiofrequency ablations of atrial tachycardia (2009 and 2010). Postoperative transient complete AV block. Implanted two-chamber pacemaker with endocardial electrodes. Congestive heart failure (CHF) stage I, NYHA functional class II. Twice reposition of the ventricular electrode due to dislocation. Class II obesity by WHO.

Prior to this hospitalization, the patient had been twice attempted to perform RF ablation of atrial tachycardia. Both procedures were ineffective, the second was complicated by a transient complete AV blockade, as a result of which a pacemaker was implanted. After repeated ablation, in the patient there were remained attacks of frequent rhythmic heartbeat (up to 5-6 times per day) with a ventricular contraction rate from 150 to 200 beats/min and with duration from 30 min to 4 hours.

Upon admission on ECG (Fig.1), there is sinus rhythm with heart rate (HR) 85 beats/min, frequent APB. During transesophageal electrophysiological examination, paroxysm of regular atrial tachycardia with HR 175 beats/min was induced. Echocardiographic examination showed that cavities size is not enlarged, left ventricular ejection fraction (EF) was 54%. According to daily ECG monitoring, frequent APB in a bigeminal pattern, short runs of atrial tachycardia with HR 125-180 beats/min was

Fig. 2. Mapping of patient K. Paroxysmal atrial tachycardia with heart rate up to 120 beats/min.

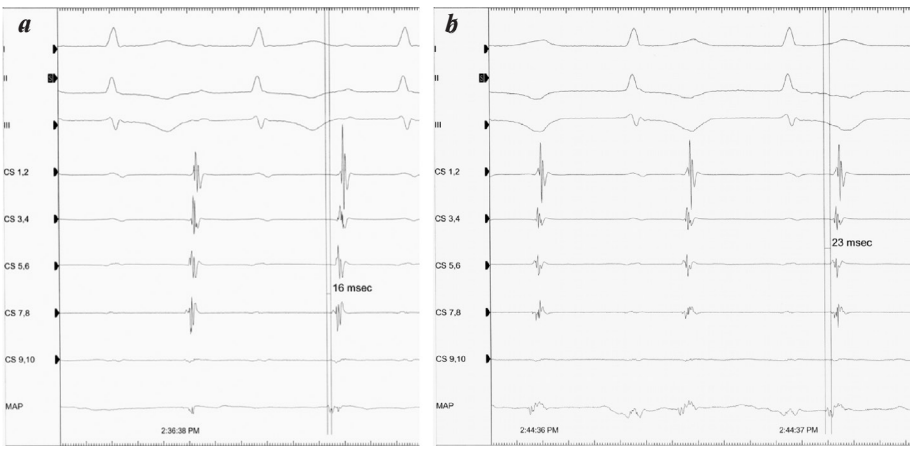

Fig. 3. Activation mapping of the arrhythmia substrate of patient K. in the atrial septum from the left atrium (a) and the right atrium (b).

recorded. When examining the implanted pacemaker, there was no dysfunction of the device, right ventricular stimulation was no more than 10%.

The surgery was conducted using the navigation system CARTO-3. Under local anesthesia, punctures of the subclavian and femoral veins, as well as further femoral artery, were performed. A diagnostic electrode is placed in CS. Short paroxysms of atrial tachycardia without a clear front of excitation propagation along the CS were recorded (Fig. 2). Atrial septum puncture was performed. During paroxysmal atrial tachycardia, an activation map of the left and right atria was constructed. At navigational mapping, the earliest possible activation of the arrhythmia substrate was determined in the anterior-septal region of the right atrium (-25 ms) (Fig. 3) in close proximity to the AV connection. The distance from the zone of the earliest atrial activation to the mapping of His bundle was not more than 5 mm. Due to the high risk of unintentional AV blockade, a series of radiofrequency interventions were performed (temperatures up to 43 °C, power 25W, irrigation feed rate 18 ml/min) in areas as close as possible to the area of early activation. All RF exposures were not effective for arrhythmia substrate elimination.

Then, by ablation catheter through transaortic access the mapping of SV was performed. In the area of non-coronary sinus, a zone of even earlier activation of the tachycardia substrate (-28 ms) was determined (Fig. 4). In this area, a series of RF exposures was performed. A convection electrode was used with the following ablation parameters: temperature up to 55° C, power 35 W. There was noted a relief of paroxysm of atrial tachycardia and atrial ectopic activity in the first seconds of the first RF exposure. When conducting a control intracardiac electrophysiological examination using various pacing protocols, atrial rhythm disturbances are no longer induced. The postoperative period was without complications.

DISCUSSION

According to the literature and our clinical experience, patients with a focal form of atrial tachycardia consist no more than 5% of the total number of patients with tachyarrhythmias [23]. Our experience has shown that the effectiveness of its treatment is quite high. However, some localizations of the ectopic atrial substrate can be difficult for successful mapping and ablation: in particular, anterior-septal localization. According to aggregate data, the proportion of such patients can be 4-12% of the total number of patients with focal atrial tachycardia [12, 13, 15]. An important aspect of the effective treatment of tachycardia of this localization is the determination of the area of the earliest substrate activation [20]. This may require mapping of the interatrial septum, both from the left and right atria, as well as from the non-coronary SV [24].

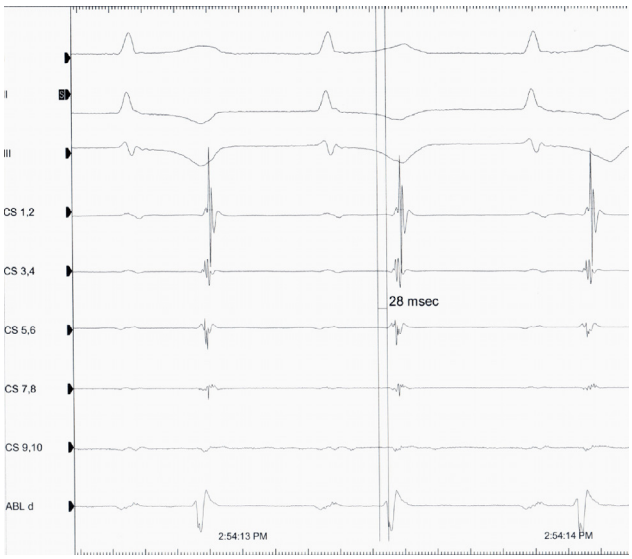

Fig. 4. Activation mapping of patient K. from the non-coronary sinus of Valsalva.

To date, there is no consensus on the mechanisms of the focal form of atrial tachycardia. Three priority versions are considered: increased automatism, trigger activity, and micro re-entry [21]. In favor of non-re-entry dependent mechanism of this form of tachyarrhythmias, in particular, the fact that focal RF or cryo ablation in the area of the earliest atrial activation are always effective and stop tachycardia. This type of tachycardia can almost always be stably induced and stopped when performing program and asynchronous cardiac stimulation.

Analysis of the morphology of the P-wave on a surface ECG in 12 leads gives very limited information in determining the specific location of the tachycardia substrate at the preoperative stage. A marker of the anterior-septal localization of the tachycardia substrate can be a positive P-wave in I and aVL leads, negative or isoelectric in II, III and aVF leads and a two-phase P wave in precordial leads V1 and V2. At the same time, the analysis of the morphology of the P-wave may be difficult due to its possible imposition on the tooth T.

Previously published materials detected the prevalence of the female contingent among patients with atrial tachycardia of anterior-septal substrate localization [12, 13, 15], which is consistent with our observations, where all three patients were women. Our practice has shown that an accurate determination of the localization of the substrate of atrial tachycardia in the anterior-septal region, as a rule, requires extensive mapping of the atrial septum, both from the right and left atria. In case of localization of early atrial activation in the area of visualization of His bundle, we recommend mapping of non-coronary SV and, when verifying earlier ectopic atrial activation, perform RF exposure in this zone. In our observations, the effect of stopping tachycardia was revealed in all patients already in the first seconds of exposure. All RF ablations were performed with convection electrodes without irrigation. At the same time, in our practice there was a clinical case when RF ablation in non-coronary SV was not effective, and the zone of maximally early activation was located in the visualization region of the His bundle in the right atrium. In this case, we used focal cryoablation with a positive clinical result. Thus, access from non-coronary SV for RF ablation of atrial tachycardia with localization of the substrate from the anterior-septal region of the atrial septum is safe and increases the efficiency of the procedure.

REFERENCES

1. Rosenqvist M, Lee MA, Moulinier M et al. Long-term follow-up of patients after transcatheter direct current ablation of the atrioventricular junction. *J Am Coll of Cardiol* 1990; 16 (6) 1467-1474.
2. Kalman JM, Olgin JE, Karch MR et al. 'Cristal tachycardias': origin of right atrial tachycardias from the crista terminalis identified by intracardiac echocardiography. *J Am Coll Cardiol* 1998;31:451-9.
3. Volkmer M, Antz M, Hebe J, Kuck KH. Focal atrial tachycardia originating from the musculature of the coronary sinus. *J Cardiovasc Electrophysiol* 2002;13: 68-71.
4. Gonzalez MD, Contreras LJ, Jongbloed MR et al. Left atrial tachycardia originating from the mitral annulus-aorta junction. *Circulation* 2004;110:3187-92.
5. Morton JB, Sanders P, Das A et al. Focal atrial tachycardia arising from the tricuspid annulus: electrophysiologic and electrocardiographic characteristics. *J Cardiovasc Electrophysiol* 2001;12:653-9.
6. Roberts-Thomson KC, Kistler PM, Haqqani HM et al. Focal atrial tachycardias arising from the right atrial appendage: electrocardiographic and electrophysiologic characteristics and radiofrequency ablation. *J Cardiovasc Electrophysiol* 2007;18:367-72.
7. Yamada T, Murakami Y, Yoshida Y et al. Electrophysiologic and electrocardiographic characteristics and radiofrequency catheter ablation of focal atrial tachycardia originating from the left atrial appendage. *Heart Rhythm* 2007;4:1284-91.
8. Kistler PM, Sanders P, Fynn SP et al. Electrophysiological and electrocardiographic characteristics of focal atrial tachycardia originating from the pulmonary veins: acute and long-term outcomes of radiofrequency ablation. *Circulation* 2003;108:1968-75.
9. Iesaka Y, Takahashi A, Goya M et al. Adenosinesensitive atrial reentrant tachycardia originating from the atrioventricular nodal transitional area. *J Cardiovasc Electrophysiol.* 1997;8:854-864.
10. Lai LP, Lin JL, Chen TF et al. Clinical, electrophysiological characteristics, and radiofrequency catheter ablation of atrial tachycardia near the apex of Koch's triangle. *Pacing Clin Electrophysiol.* 1998;21:367-374.
11. Chen CC, Tai CT, Chiang CE et al. Atrial tachycardias originating from the atrial septum: electrophysiologic characteristics and radiofrequency ablation. *J Cardiovasc Electrophysiol.* 2000;11:744-749.
12. Ouyang F, Ma J, Ho SY et al. Focal atrial tachycardia originating from the non-coronary aortic sinus: electrophysiological characteristics and catheter ablation. *J Am Coll Cardiol.* 2006;48:122-131.
13. Rillig A, Meyerfeldt U, Birkemeyer R et al. Catheter ablation within the sinus of Valsalva-a safe and effective approach for treatment of atrial and ventricular tachycardias. *Heart Rhythm.* 2008;5:1265-1272.
14. Kriatselis C, Roser M, Min T et al. Ectopic atrial tachycardias with early activation at His site: radiofrequency ablation through a retrograde approach. *Europace.* 2008;10:698- 704.
15. Das S, Neuzil P, Albert CM et al. Catheter ablation of peri-AV nodal atrial tachycardia from the noncoronary cusp of theaortic valve. *J Cardiovasc Electrophysiol.* 2008; 19:231-237.
16. Liu X, Dong J, Ho SY et al. Atrial tachycardia arising adjacent to noncoronary aortic sinus: distinctive atrial activation patterns and anatomic insights. *J Am Coll Cardiol.* 2010;56: 796-804.
17. Wang Z, Liu T, Shehata M, Liang Y et al. Electrophysiological characteristics of focal atrial tachycardia surrounding the aortic coronary cusps. *Circ Arrhythm Electrophysiol.* 2011; 4:902-908.
18. Ju W, Chen M, Yang B et al. The role of noncoronary cusp ablation approach in the treatment of perinodal atrial tachycardias. *Pacing Clin Electrophysiol.* 2012;35:811-818.
19. Traykov VB Mapping Strategies in Focal Atrial Tachycardias Demonstrating Early Septal Activation: Distinguishing Left From Right. *Curr Cardiol Rev.* 2015 May; 11(2): 111-117.
20. Yang JD, Sun Q, Guo XG et al. Focal atrial tachycardias from the parahisian region: Strategies for mapping and catheter ablation. *Heart Rhythm.* 2017 Sep;14(9):1344-1350.
21. Roberts-Thomson KC, Kistler PM, Kalman JM. Atrial tachycardia: mechanisms, diagnosis, and management. *Curr Probl Cardiol.* 2005;30:529-573.
22. Beukema RJ, Smit JJ, Adiyaman A et al. Ablation of focal atrial tachycardia from the non-coronary aortic cusp: case series and review of the literature. *Europace.* 2015 Jun;17(6):953-61.
23. Busch S, Forkmann M, Kuck KH et al. Acute and long-term outcome of focal atrial tachycardia ablation in the real world: results of the german ablation registry. *Clin Res Cardiol.* 2018 May;107(5):430-436.
24. Lyan E, Toniolo M , Tsyganov A , et al . Comparison of strategies forcatheter ablation of focal atrial tachycardia originating near the His bundleregion. *Heart Rhythm.* 2017 Jul;14(7):998-1005.