https://doi.org/10.35336/VA-2022-4-09

ELIMINATION OF A RIGHT-SIDED ACCESSORY PATHWAY USING A VIDEOTHORACOSCOPIC APPROACH AFTER FAILED RECURRING CATHETER ABLATION: CLINICAL CASE

E.S.Malishenko[1], E.A.Artyukhina[1], E.D.Strebkova[2], A.Sh.Revishvili[1]

[1]Federal State Budgetary Educational Institution "A.V.Vishnevskiy National Medical Research Center of Surgery" of the Ministry of Healthcare of the Russian Federation, Moscow, 27 Bolshaya Serpukhovskaya str.;

[2]Federal State Budgetary Educational Institution of Further Professional Education "Russian Medical Academy of Continuous Professional Education" of the Ministry of Healthcare of the Russian Federation, Moscow, 2/1 Barrikadnaya str, building 1.

The description of the clinical case presents a rare observation of a multi-stage approach to the treatment of right-sided accessory pathway. There are presented the results and features of successful epicardial ablation using a minimally invasive thoracoscopic approach, which made it possible to eliminate accessory pathways for right-sided epicardial localization after failed recurring cataract ablations.

Keywords: preexcitation syndrome; accessory pathways; cryoablation; radiofrequency ablation; thoracoscopic ablation

Conflict of Interests: nothing to declare
Funding: none
Received: 16.03.2022 **Revision received:** 18.04.2022 **Accepted:** 29.05.2022
Corresponding author: Strebkova Elizaveta, E-mail: E-mail:elizabeth.strebkova@yandex.ru

E.S.Malishenko - ORCID ID 0000-0002-1572-3178, E.A.Artyukhina - ORCID ID 0000-0001-7065-0250, E.D.Strebkova - ORCID ID 0000-0001-5837-7255, A.Sh.Revishvili - ORCID ID 0000-0003-1791-9163

For citation: Malishenko ES, Artyukhina EA, Strebkova ED, Revishvili ASh. Elimination of a right-sided accessory pathway using a videothoracoscopic approach after failed recurring catheter ablation: clinical case. *Journal of Arrhythmology.* 2022;29(4): 61-65. https://doi.org/10.35336/VA-2022-4-09.

The presence of an accessory atrial-ventricular pathway (AP), along with the normal atrioventricular junction (AVJ), is a substrate for the occurrence of tachycardia by the re-entry mechanism. The presence of AP can cause life-threatening conditions, such as ventricular fibrillation, which accounts for 2.4% of other fatal arrhythmias [1]. According to C.Pappone et al. the total risk of sudden cardiac death in this category of young people can be 0.3% per year [2], which necessitates radical elimination of AP.

Catheter ablation has been the method of choice in the treatment of pre-excitation syndromes for more than 30 years. Modern mapping techniques and catheter technology using different electrodes for endocardial ablation: convection, irrigated, cryocatheters, allow for electrode positioning and effective removal of AP of any localization. About 60% of APs are located along the mitral valve (left-sided), about 15% along the tricuspid valve (right-sided), and about 25% are in the septal area (septal and paraseptal).

The efficiency of catheter ablation of AP is more than 95%, and taking into account repeated procedures - 97%

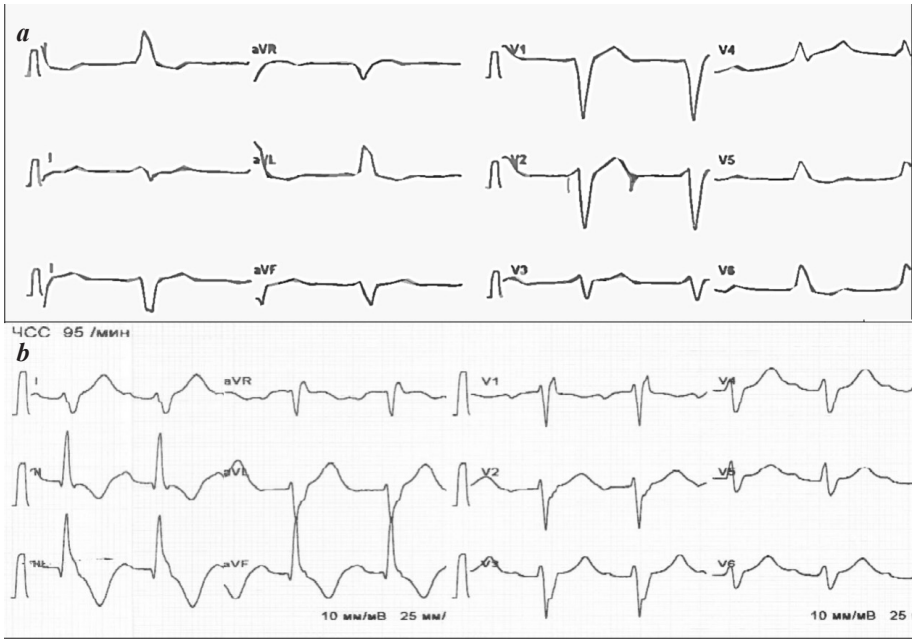

Fig. 1. Electrocardiograms of the patient: a - before thoracoscopic ablation (right ventricular pre-excitation syndrome), b - after removal of the accessory pathway (absence of delta wave. PQ interval greater than 200 ms, right bundle branch block).

[1]. However, a proportion of reoperations are for right-sided and paraseptal AP, which in some cases requires the use of additional instruments: special long intraductors with fixed or variable curvature to ensure a more stable position of the ablation catheters in the right atrioventricular sulcus (AVS), and the use of irrigated electrodes or cryoenergy for deeper energy penetration. The presented clinical case demonstrates a multistage approach to eliminate right-sided epicardial AP using different technologies.

The patient's condition has been known since childhood and her ECG has consistently recorded a delta wave (right-sided AP). Since the age of ten, she has had palpitations of up to 200 beats per minute, which are relieved by vagus tests. At the age of 14, the patient underwent the first electrophysiological examination (EPE) and radiofrequency ablation (RFA) of AP. From the operation protocol: femoral and right subclavian vein puncture, standard electrode positioning into coronary sinus and right ventricle, mapping ablation electrode into right AVS area. In retrograde stimulation, conduction by AP of right-sided localization. At a coupling interval of 600-380 ms, stable induction of orthodromic tachycardia (ORT) with a cycle length (CL) of 380 ms. In antegrade programmed stimulation, an AP conduction with increasing pre-excitation to an antegrade effective refractory period (AERP) AP of 300 ms, also with ORT induction.

When mapping at sinus rhythm and tachycardia, the earliest activation zone is identified in the right anterior region of the AVS, but no good criteria (confluent component) were obtained. Several RFAs were performed using convection and then and irrigated electrode, with changing of different variants of introducers with fixed and controlled curvature total ablation time of about 25 min without effect. The patient was discharged under observation.

The complaints of tachycardia paroxysms have persisted for a year, while taking antiarrhythmic drugs (amiodarone). The patient was offered repeat RFA surgery. Electrophysiological characteristics during EPE and the results of AP mapping are the same. Additionally, several

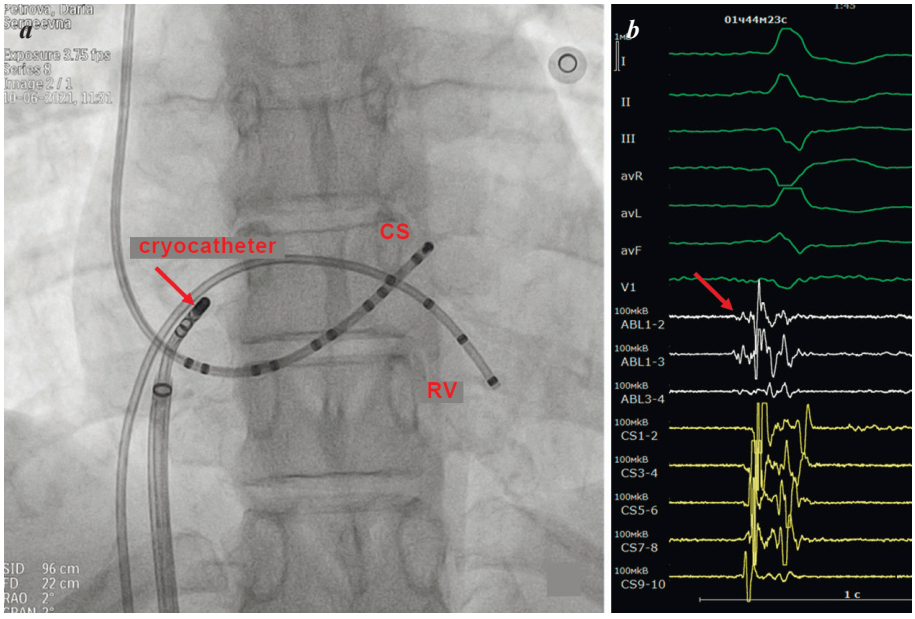

Fig. 2. Endocardial cryoablation: a - radiograph (cryocatheter positioned in the anterior superior region of the atrioventricular sulcus, ten pole electrode in the coronary sinus - CS, four pole electrode in the right ventricle - RV); b - endocardial electrogram during cryoablation in the earliest zone (I, II, III, aVR, aVL, aVF, V1 - external ECG leads, Abl 1-4 - endocardial electrograms from cryocatheter, red arrow shows fragmented activity in place of cryoablation, CS 1-10 - electrograms from electrode placed in CS).

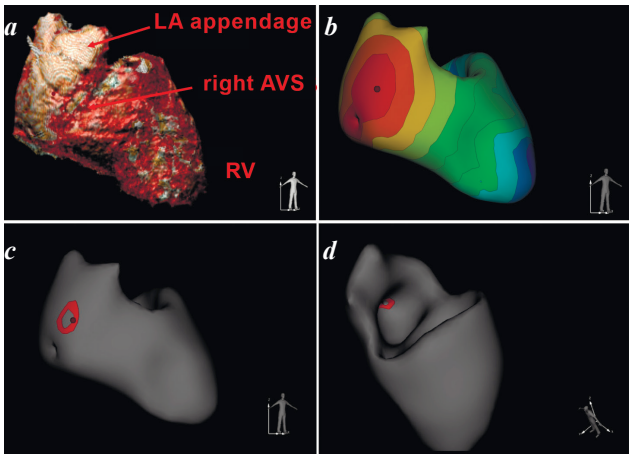

Fig. 3. Results of non-invasive mapping: a - computer model of the right atrium (RA) and right ventricle (RV), with the right atrioventricular sulcus (AVS) and RV marked in red; b - activation model, the area of earliest pre-excitation from the epicardial surface of the heart marked in red; c - spread of excitation on the epicardial surface of the heart, d - on the endocardial surface.

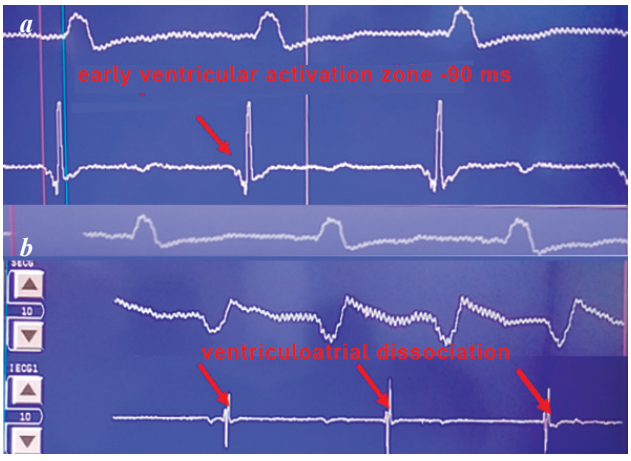

Fig. 4. Electrograms during thoracoscopic cryoablation: a - recording from a monopolar electrode during epicardial mapping (C2 early ventricular activation zone -90 ms to C1 ventricular electrogram); b - ventriculoatrial (VA) dissociation during right ventricular stimulation (15 mA, 120 beats per minute)

cold RFAs were performed in the earliest activation zone on tachycardia and sinus rhythm at maximal pre-excitation. The procedure has no effect. The patient and her parents refused the proposed open-heart surgery. Given the lack of effect of ablation, frequent paroxysms of tachycardia. It was decided to perform a modification of the AVJ. Several RFAs have been performed in the AVJ projection with the effect of increasing pre-excitation on sinus rhythm and the inability to induce tachycardia by programmed atrial and ventricular stimulation.

There were no complaints of tachycardia for 10 years. However, in the last 5 years, firstly occasional and later more frequent (up to 1-2 times a month) paroxysms of tachycardia with a ventricular rate of 130 per minute, relieved either by itself or by vagus testing have occurred. At the age of 31, the patient again applied for an EPE and an attempt to eliminate AP. A delta wave is recorded on the ECG (Fig. 1a).

Intraoperatively - after electrode positioning, antegrade programmed atrial stimulation was carried out - AP conduction to AP AERP - 290ms. Further, there is no conduction on the AVJ. Tachycardia is not induced. When performing retrograde programmed stimulation, AP conduction. At the clutch interval S1-S2 = 380 ms and baseline stimulation S1-S1 = 600 ms, there was induction of ORT with a slower CL of 465 ms, which was repeatedly terminated by frequent atrial stimulation with CL = 320 ms.

Mapping of the right AVS on tachycardia and on sinus rhythm was performed. An early zone of ventricular myocardial activation (without a draining component) is noted in the wide area of the anterior-upper AVS (10-11 hours, anterior-upper by Cosio classification). A series of RFA with an irrigated electrode has been performed in this area - with no effect. Ablation parameters: power 32 W, temperature 44 oC. The total exposure time was 16 minutes. The ablation catheter was replaced by a Freezor cryocatheter, inserted into the right atrium (RA) through a Fast-Cath Flex intraductal connector. A series of cryo-exercises on preexcision was performed without effect. The ante- and retrograde AP conduction with initial electrophysiological parameters was preserved (Fig. 2). This completes the procedure.

To clarify the epicardial location of AP, we performed noninvasive cardiac mapping using the AMICARD hardware and software system. A breakthrough of excitation from the epicardial surface of the heart (10 ms ahead of activation from the endocardial surface) was verified in the anterior portion of the AVS in the projection of the auricle of RA (Fig. 3). The patient was offered surgical correction and agreed to epicardial ablation using a video-thoracoscopic technique with possible thoracotomy.

A three-port right-sided access was performed in the cardiac surgery operating room. The right pleural cavity was visualized. A longitudinal pericardiotomy was performed. Pericardium was in the holders, diluted. There was an episode of ORT with a frequency of up to 130 bpm. Tachycardia was stopped by stimulation from the epicardial surface of RA. On visualization of AVS, foci of fibrotic changes from previously performed multiple endocardial interventions. Right AVS mapping was performed using a monopolar electrode with drain component verification and -90 ms advance to delta wave (Fig. 4a)

In the area of maximal early activity, a series of treatments in the transition zone of the free wall of the right atrium and AVS were performed five times using a modifiable cryoapplicator, with gradual movement of the applicator along the AVS. Cryo-applications were performed with an Atricure cryoapplicator (-62°C) for 120 seconds, for a total of three cryo-applications in ventricular AVS with disappearance of delta wave and long PQ interval (Fig. 5). In antegrade stimulation, there was no conduction along the AP. In retrograde stimulation, ventriculoatrial dissociation (Fig. 4b).

Postoperative period without complications. The patient was discharged on the 5th day. Follow-up period was 1 year, no delta wave on ECG, no complaints of tachycardia (Fig. 1b). Regular daily ECG monitoring revealed a stable sinus rhythm. The patient underwent coronary angiography 3 months later: coronary arteries without stenoses, including the area of cryoventilation.

DISCUSSION

In 1968 W.Sealy was the first to describe the operation of radical elimination of AP using open-heart surgery [3]. The operation went down in history, was called Operation Sealy, and has long been an effective treatment for pre-excitation syndromes, including combined operations to correct congenital heart defects such as Epstein anomaly.

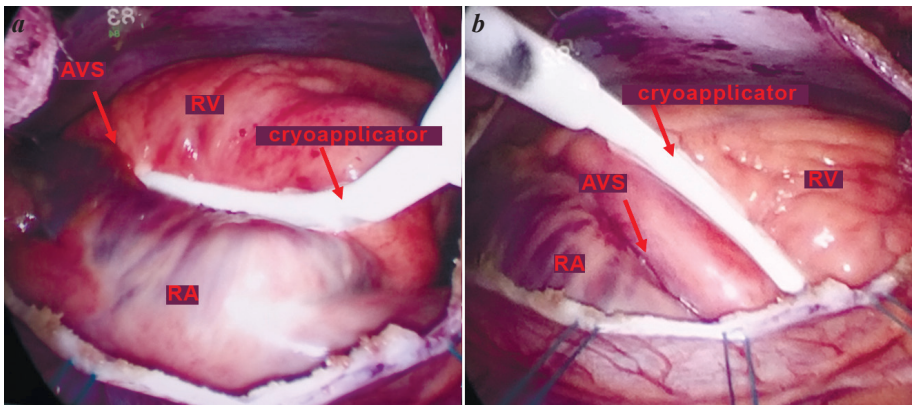

Fig. 5. Thoracoscopic imaging during cryoablation of the extra atrial-ventricular junction: a - cryoapplicator in the right atrioventricular sulcus (AVS), b - shifted to its ventricular part.

With the advent and good results of catheter-based treatment, surgery to remove AP using surgical approaches is very rare, mainly in cases of failed endocardial ablation. And the use of alternative energy sources - radiofrequency and cryoenergy - has completely replaced the classic surgical approach.

There have been a number of reports of a small series of successful epicardial ablation of AP, in the open heart after unsuccessful endocardial ablations,

usually for right-sided or paraseptal localizations or in patients with congenital heart disease [4, 5].

In the presence of right-sided epicardial AP, a subxiphoidal approach is sometimes used to perform epicardial ablation as an alternative to 'open' surgical treatment. This technique is more commonly used in patients with paraseptal AP or coronary sinus diverticula, which in some cases makes endocardial ablation difficult to perform [6-9].

In recent years, with the introduction of videothoracoscopic techniques and minimally invasive surgery into clinical practice, sporadic publications have appeared on their use as an effective and safe approach for the management of right-sided AP after failed endocardial ablations [10].

To accurately visualize the zone of early activation on the epicardial or endocardial surface in the AVS area and choose the epicardial access accordingly, multichannel cardiac mapping was performed. According to E. Wissner et al. this diagnostic method has proved to be highly accurate for definition of a place of early activation in ventricular rhythm disturbances, allowing to successfully plan an ablation strategy [11].

Our clinical observation presents the evolution of methods and approaches to eliminate anterior epicardial right-sided AP, including repeated attempts to eliminate the extra pathway using radiofrequency energy and catheter-assisted cryoablation. Given our considerable and longstanding experience in thoracoscopic ablation of arrhythmias, we have successfully applied a minimally invasive technique without the need for open surgery under thoracotomy and bypass.

CONCLUSION

In the presented case, a thoracoscopic technique was used to remove right-sided epicardial anterior-upper AP in a patient after repeated unsuccessful catheter ablations. Minimally invasive technology has been shown to be effective and safe. The method may well be an alternative in patients with pre-excitation syndromes with epicardial location of AP in patients after ineffective endocardial catheter ablations.

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