

Catheter ablation of common atrioventricular nodal reentry tachycardia using the conventional method

Received: 19/4/2018

Accepted: 9/9/2018

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Abstract

Background and objective: Atrioventricular nodal reentry tachycardia is the commonest type of supraventricular tachycardia referred to the electrophysiology laboratory. It constitutes about two thirds of the supraventricular tachycardia admitted to the emergency department. The mechanism of this tachycardia is reentry. This study aimed to evaluate the efficacy of radiofrequency ablation therapy in atrioventricular nodal reentry tachycardia as the first line treatment using the conventional method.

Methods: The standard technique for the electrophysiological study done to induce tachycardia. Three or four catheters were used. Atrial or ventricular programmed stimulation used to induce the tachycardia. Differentiation of the atrioventricular nodal reentry from atrial tachycardia and atrioventricular tachycardia done by ventricular entrainment. The dry ablation catheter of 4 mm tip used to modify the slow pathway. The appearance of junctional rhythm was a sign of the effective application of the radiofrequency application. The success of ablation was indicated by a failure to induce the tachycardia with repeated programmed stimulation.

Results: Seventy patients with atrioventricular nodal reentry tachycardia were selected from total supraventricular tachycardia cases of 106 patients referred to the catheter lab for radiofrequency ablation. In 85% of the cases atrial programmed stimulation were used to induce the tachycardia and ventricular programmed stimulation and in 15% of the cases. Acute success rate was seen in 68 patients (97%).

Conclusion: Catheter radiofrequency ablation is becoming technically easy, safe, and reliable as first line treatment in the majority of patients with atrioventricular reentry tachycardia.

Keywords: Atrioventricular nodal reentry tachycardia; Catheter ablation; First line treatment.

Introduction

Atrioventricular nodal reentry tachycardia (AVNRT) is the most common form of regular narrow complex tachycardia (RNCT) referred to the catheter laboratory for ablation therapy.¹ AVNRT more commonly occurs in patients without structural heart disease. It is more common in females than in males.^{1,2} The mechanism of AVNRT is reentry using two pathways one is slow, and the other is fast, they are anatomically located at the triangle of Koch at the right atrium, the fast is close to the His bundle while the slow is just

above the coronary sinus os.³⁻⁵ The slow pathway is the antegrade conducting pathway, and the fast is the retrograde conducting pathway in the common type of AVNRT which is labeled accordingly as the slow/fast (s/f) type while the uncommon type is characterized by the fast pathway is conducting antegradely and the slow one conducting retrogradely and called fast/slow (f/s) type.¹⁻⁶ The superficial Electrocardiographic features of AVNRT are 1, RNCT.2, either no P' seen where it is embedded within the QRS or P' seen just after the QRS as a pseudo r wave

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in V1 and a VR and /or pseud s in leads II, III and aVF (Figure 1).^{1,2} The electrophysiological characteristics include 1) AH interval jump during atrial programmed stimulation and induction of the tachycardia, 2) during SVT a short VA interval less than 80msc, and 3) with ventricular over drive stimulation (ventricular entrainment) during the SVT a VAV pattern seen with a post pacing interval (PPI) –Tachycardia Cycle length (TCL) is more than 118 msc (Figure 2).^{2,5} Catheter radiofrequency catheter ablation therapy (CRFAT) targeting the fast or the slow pathway has been used for more than two decades.³⁻⁶ The slow pathway ablation became the most widely used.^{1,2} In Iraq, the first slow pathway CRFAT was done at Kadhiymia teaching hospital in 2001, and at Nasiriya Heart Centre in 2007.¹⁰ In Kurdistan, it was done in 2011 at Alhassani cardiac center at Sulaimanya. More recently, more cases are done using the new system of Cartoo and the Ensite at Najaf and Nasiriya heart centers. This study aimed to evaluate the efficacy of radiofrequency ablation therapy in atrioventricular nodal reentry

tachycardia as first line treatment using the conventional method.

Methods

From November 2011 to December 2017, 106 patients with SVT referred to the catheter lab at Alhassani cardiac center. Seventy patients who fulfilled the criteria of AVNRT were included in this study. The mean age of the patients was 46.8±15 years (range 24-55 years). Sixty patients were females, and ten patients were males. The main symptoms they presented with were palpitation in 100%, dizzy spells encountered in 35%, and pre syncope in two patients. The indication of CRFAT was drug inefficacy in 40 patients and as first line therapy in 30 patients. In 15 patients, RF ablation was first line therapy because of severe symptoms, and in 15 was due to patient preference for ablation versus drug therapy. All patients underwent basic 12 leads electrocardiogram (ECG), and all available ECGs during tachycardia and sinus rhythm were carefully inspected for the ECG signs suggesting AVNRT Figure 1. Basic blood biochemistry, thyroid function tests, and chest X-ray (CXR) were done.

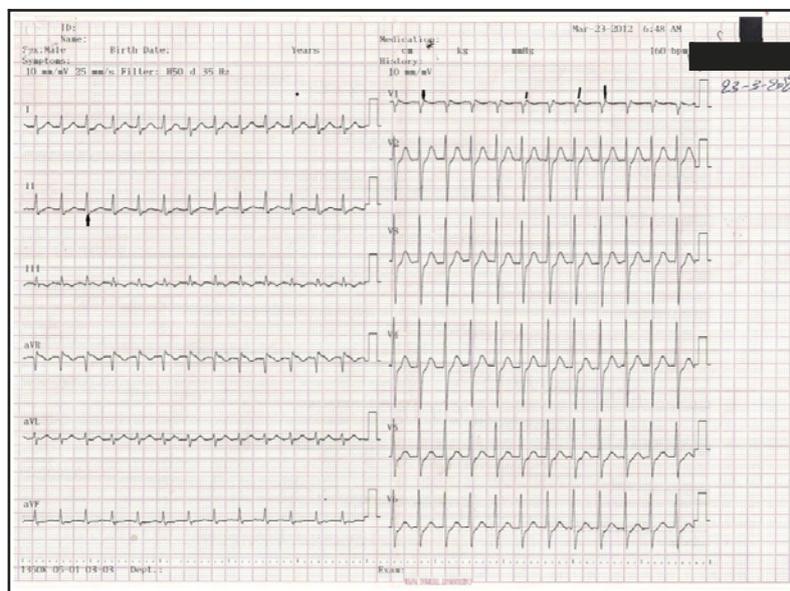


Figure 1: Twelve leads ECG of SVT showing RNCT of short RP long PR type and pseudo r wave at V1 and aVR and pseudo s wave at lead II (arrows). These features are suggesting common s/f type AVNRT.

Electrophysiological study

Electrophysiological study (EPS) was done using conventional EP System, GE Medical Systems Cardio Lab v5.2, and Bloom cardiac stimulator with Boston Scientific (BS) ablation generator. All antiarrhythmic drugs omitted for a period of at least 14 days before the EPS. Skin sterilization and then 2% xylocaine used for local anesthesia of the left and right inguinal area for femoral veins (FV) approach where triport 14 F sheaths introduced on the right FV and 7F sheath at the left FV. Under fluoroscopy, three Quadripolar EP catheters from Boston Scientific (BS) or Access Point Technology (APT) introduced through the right femoral vein sheath and positioned at the RA, His, and RV apex subsequently. In a few patients, coronary sinus catheter introduced if deemed necessary. Basic conduction measurements were done, and

then induction of the arrhythmia attempted with atrial programmed stimulation (APS), and when AH interval jump observed, this indicates dual AV nodal physiology. Ventricular programmed stimulation (VPS) used if the SVT was not induced by APS. The induced SVT is diagnosed as s/f AVNRT if three criteria are seen. First, AH jump of more than 50msec with reducing the APS pacing cycle length of 10msec. Second, VA interval during SVT is less than 80msec. Third, with ventricular entrainment (ventricular stimulation during the SVT) VAV pattern seen after cessation of VPS and PPI minus TCL more than 118 msec (Figures 2 and 3). Atypical (f/s) AVNRT were not included in this study. AT and AVRT were excluded through the ventricular entrainment maneuver mentioned above. The SVT was terminated by APS after confirming the diagnosis of s/f AVNRT.

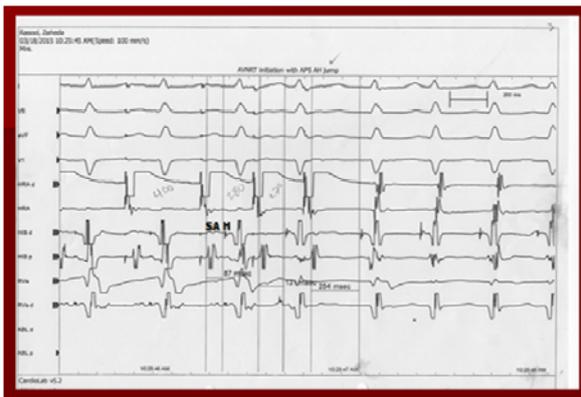


Figure 2: The EP trace shows atrial programmed stimulation where AH interval jump is followed by SVT induction, this is highly suggesting AVNRT s/f type. The speed of recording is 100mm/sec.

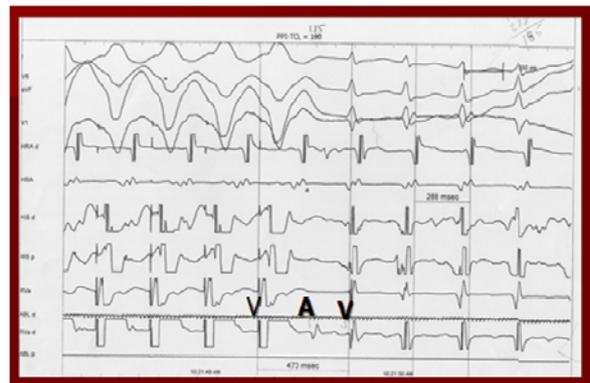


Figure 3: Ventricular entrainment maneuver during the SVT showing PPI-TCL of 185msec and VAV pattern, suggesting s/f AVNRT and excluding AT & AVRT. The speed of recording is 100mm/second.

Catheter radio frequency ablation procedure

After confirming the diagnosis of common s/f AVNRT done by EP study, a 4 mm tip dry ablation catheter from BS or APT introduced through the left femoral vein sheath and positioned at the lower posterior part of Koch triangle just above the CS os where the SP is sited. Ablation is always done during sinus rhythm and no ablation done during the SVT. Once a satisfactory anatomical position achieved through RAO and LAO fluoroscopy view and once an electrocardiogram (EGM) trace at the distal pole of the ablation catheter showed an A to V ratio of 1/5-10 with or without slow pathway potential, the RF delivery started with temperature control mode and delivering 35 Watt for 1 minute to achieve a temperature of 60-70 degree centigrade. The RF delivery is done

in a titrating pattern to minimize the occurrence of AV block. The main sign of successful RF delivery is the appearance of junctional rhythm (JR) which if not appeared within 10 seconds RF delivery will be stopped and a better position of the ablation distal pole achieved. If quite fast JR appeared and VA block seen, RF delivery is stopped immediately to avoid the occurrence of AV block (Figure 4). Slow JR is a good sign of effective RF delivery and successful SP ablation. The radiological feature of the catheters position is shown in Figure 5. The end point of ablation is non inducibility of the AVNRT with APS and VPS without and with isuprinaline infusion. The ethical and scientific committee has approved the work included in this study. Simple statistics used to calculate the percentage of variables.



Figure 4: The appearance of fast junctional rhythm and transient AV block with the RF application. The speed of recording is 25 mm/sec.

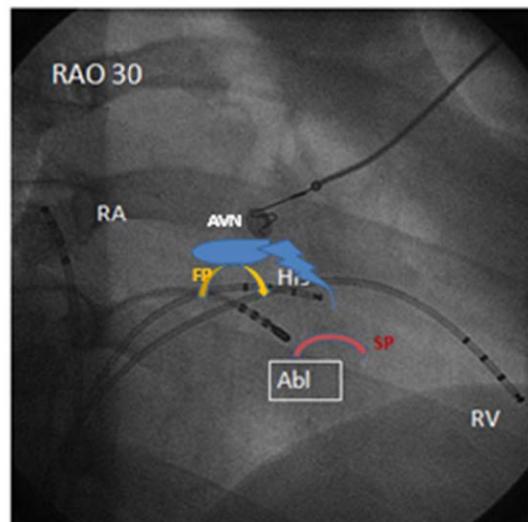


Figure 5: X-ray showing the EP and ablation catheters position in correlation to the slow and fast pathway site.

Results

Among the 70 patients included in this study, 68 (97%) patients had acute success with non inducibility of the tachycardia at the end of the ablation procedure. In two patients, the procedure failed, and the tachycardia still inducible after ablation where a left-sided SP was suspected. In one patient, fast pathway ablation done after the failure of slow pathway ablation, which resulted in success and non inducibility of the SVT but a first degree heart block developed with a PR interval of 240 msc and prolonged AH interval of 185 msc but a normal HV interval. Complete atrioventricular (AVB) block occurred in three patients; in two of them, the AVB persisted and a permanent pacemaker implanted, and in one patient, the AVB resolved within 24 hours. Junctional rhythm appeared in all patients with successful ablation. The average procedure time was 72 ± 21 minutes, and fluoroscopy time was 10 ± 5.4 minutes. The follow up period ranged from 1.5-6 years. There was a recurrence in two patients after six months, and one year, in both a second ablation was done and followed for two years with no recurrence. All patients discharged from the hospital on the same day within 4-8 hours after the procedure, and they are advised to rest for 24 hours after which they can resume normal daily life activities.

Discussion

Atrioventricular nodal reentry tachycardia of the s/f type accounts about 85% of the AVNRT and 75% of the RNCT seen in the ED or the cath lab. The presenting symptomatology previously described by Katritsis were palpitation in 96%, dizziness in 75%, dyspnea in 47%, and syncope in 0.5%.¹ We noticed palpitation in 100%, dizziness in 35%, and syncope in 20% and dyspnea in 40%. In other authors series the incidence of these symptomatology almost the same.^{1,8,10} AVNRT is commonly seen in a structurally normal heart, but patients with structural heart disease

occasionally develop AVNRT. In our series, only three patients (4%) had previous IHD. In other's series structural heart disease was seen in 6-19%.^{1,5,10} The common s/f type is far more common than the uncommon f/s type.¹⁰⁻¹² In our study, only s/f type are included. Findings a cure has always been the main goal of therapy.^{5,7,8,9,11-13} When ablation therapy was first used by delivering DC shock or open heart surgery ablation, it gave a hope for a future, easier, safer and highly effective ablation procedure and that is when CRFAT came over. The energy source with RF became so well controlled and refined the ablation results became highly encouraging to achieve total cure of many arrhythmias and on the top of the list is the AVNRT.^{13,16-19,21,22} The outcome of ablation therapy in AVNRT varies amongst many series due to different factors like facilities, experience and teamwork including experts in the field of ablation.^{1,10,17,21} The improvement in the results of ablation is mainly due to the development of anatomical and electrical mapping procedures and precisely defining the slow pathway ablation site.^{8,14-18,21,22} We followed these mapping procedures in our study by simplifying the procedure process by reducing the number of catheters used, using precise differentiating maneuvers, and applying radiofrequency in titrating pattern. These precisions are partly used by other authors.^{2,5,7} Accordingly, to achieve high success rate in AVNRT ablation, we need 1) well set EP and ablation generator systems, 2) trained medical and technical staff, 3) reliable X-ray fluoroscopy set up with RAO and LAO projection, and 4) EP and ablation catheters. We started with self-training program locally at Kadhiymia teaching hospital, Nasiriya heart center, and then at Alhassani cardiac center in Sulaimanya where the cases included in this study. Our acute success rate was 97%, and the long term success was 97% where in two patients (3%) recurrence occurred and needed another SP ablation.

The reported recurrence rate with other studies ranged from 3-6%.^{6, 18-22} Complete atrioventricular block (AVB) developed in three patients, in two permanent pacemaker was implanted, and in one the AVB resolved after twenty four hours, these results are comparable to other series where it was seen in 3-6%.^{10,16-19,21,22} The appearance of junctional rhythm during RF delivery is considered a marker of effective RF delivery and then as a successful ablation by many authors.^{17,18-22} However, the absence of JR does not increase the risk of recurrence of the AVNRT, but technically it indicates non-effective RF delivery.^{5,21,22} In our study, JR appeared in all patients, which was considered a successful ablation. Catheter radiofrequency ablation therapy improves health-related quality of life to a greater extent than do medications and cost wise it is less expensive therapy compared to long life lasting drug therapy among patients who have one to two attacks of SVT per month.^{1,2,17,18}

Conclusion

Catheter radiofrequency ablation therapy is both safe and effective, supporting our suggestion to consider it as a first line therapy for the majority of patients with AVNRT unless the patient prefers drug therapy trial before CRFAT.

Competing interests

The author declares no competing interests.

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