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Original Research Article

Dual and Multiple AV Nodal Pathways, What is The Deference in Typical Atrioventricular Nodal Reentrant Tachycardia?

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Abstract

in adult typical atrioventricular nodal reentrant tachycardia (AVNRT) consider most common paroxysmal supraventricular tachycardia. Dual pathway idea still accepted and used widely and commonly. According to the guide line, ablations of slow pathway still the first treatment with good success rate.
Identify the electrophysiological difference of atrioventricular nodal pathways pre and post ablation.
Electrophysiological study was done to 54 patients with only typical type AVNRTs; they were 40 (74%) females and 14 (26%) males. Divided into two groups G1 with 38 patients (70.4%) having one pathway and G2 with 16 patients (29.6%) with multiple pathway. After induction we study the clinical and electrophysiological feature of tachycardia and showed faster tachycardia in G1 than G2 (330 ±56 versus 430 ±67). And the time per minute to achieve ablation or end point more in G2 than G1 (82±12.4 G2 versus 71±11.6 G1) with more energy applied in G2 versus G1 (12.4± 4.8 versus 6.3± 3.2). Complete ablation of the slow pathway was achieve in 37(69%) of total patients and only modulation occur in 17 (31%) with variation between two groups. And block not recorded in this study.
In patient with typical AVNRTs there is percentage of multiple AV pathways 29.6%, and during EP procedure those need good interpretation, analysis of tachycardia after induction, pre and post ablation, and also they need more time and energy for elimination of slow pathway as well as the used of mapping system to localized the His area before ablation is of value to prevent AV nodal injury.

Key Words: Typical AVNRT, AV node pathway, Ablation

الخلاصة

دراسة الخصائص الفيزيولوجية والكهربائية في مرضى التسارع الانيني الانتيابي النموذجي من حيت كونها ثنائية الذراع او متعددة الاذرع تم معرفتها ومقارنتها ومعرفة الية عملها اثناء التسارع ومدى تأثير الكوي في كلا الحالتيين. واستنتجت الدراسة وجود نسبة عالية ٢٩،٦% ذو فيزيولوجية متعددة الذراع وان دراسة كهربائية القلب تختلف بين المجموعتين بالوقت والسرعة ونوع وطبيعة الكوي.

الكلمات المفتاحية : التسارع الانتيابي المتكرر، العقد، الحبيبة، الكوي .

Introduction

Still the dual AV nodal physiology in atrioventricular nodal reentrant tachycardia (AVNRT) considers the most common mechanism accepted widely to explain the tachycardia [1]. 2/3 of patients with supraventricular arrhythmia accounting as AVNRT. And there is early high success rate in EP study with ablation of slow pathway [2].

The heart weather it is normal structurally or structural diseases, not affected the occurrence of arrhythmia.

There is often no apparent precipitating cause for episodes of AVNRT. However, in some patients, nicotine, alcohol, stimulants, exercise, or surges in vagal

tone can initiate episodes. Familial AVNRT has been reported [3].

The symptoms associated with arrhythmia episodes are nonspecific. The nature and severity of symptoms are often influenced by the rate of the tachycardia. Because of the paroxysmal nature of the arrhythmia, the onset and termination of the symptoms are usually sudden [4].

AVNRT consider as typical type when slow-fast form occur , that mean P wave during tachycardia come directly after R wave or fusion with S wave and give as short RP, long PR tachycardia (RA to AR , less than one). Careful mapping studies should be consider in 7.6% of typical AVNRT patients in those patients the His point was the earliest point with retrograde atrial activation and in those patients mainly there is posterior or even left septal fast pathways [5].

In our study shows we discuss the difference in electrophysiological parameter and ablation data between dual and multiple AV nodal pathways in typical form of AVNRT.

Dual AV nodal physiology

The idea of AV nodal physiology that allow for reentry mechanism involves separate electrical pathways within or proximal to the AV node. This model is supported by clinical observations as well as animal and human mapping studies. These pathways may be distinct anatomic structures, or may be functionally separate. Whether the dual pathways are anatomic or functional, the refractory period and speed of conduction should be difference or dissociated in order for reentry to occur [6]:

- In fast pathway, have relatively long refractory period with rapid conduction also called Beta pathway.
- In slow pathway, have shorter refractory period with slow conduction also called alpha pathway.

Multiple Atrioventricular Node Pathways

14% of AVNRT patients have multiple pathways of AV node. And the characteristic feature of those patients have multiple AH jump during EP study responding to atria programmed stimulation. As AH jumping more than 50 ms with increasing the premature beat from the atria. The duration of tachycardia cycle length in such patients seen to longer and in rare situation associated with multiple tachycardia cycle length [7].

Study population

We enrolled 40 patient with Typical (common type) AVNRT in this study from those patients they have AVNRT, referring for EP study and ablation.

And our plan was:

- EP study for all patients.
- Programmed stimulation and SVT induction
- Study the electrophysiological parameter
- Dividing the patients into two groups one with single Jump and another with multiple Jumps.
- Catheter ablation.
- Re induction with the same protocol before ablation.

After explain the procedure all patients gave as an agreement for electrophysiological study and catheter ablation. All anti-arrhythmic drugs had been stop at least one before the study.

In the EP laboratory while the patients of the table:

- Diazepam iv (5–10 mg).
- Monitoring of the heart rate was considered since the patient might develop dangerous arrhythmia at any time during the study.
- ECG was recording simultaneously with intracardiac electrocardiogram by surface electrodes.
- Connecting to a multichannel monitor of the EP.
- Slandered position of diagnostic EP catheter under fluoroscopy guide was made (high right atrial catheter, His and right ventricular apex catheter).
- With 4 mm no irrigated tip catheter standby for ablation after study and induction.

At the beginning measurements at the baseline were recorded, and in order to assess the AV conduction system and

pathways, the electrical programmed stimulation administered in different type and site, after that again reassessment to see if there is any changes from baseline.

The stimulation protocol that we used to induce SVTs in typical AVNRT:

- Determination refractory period of atria, antegrade atrioventricular refractory periods and retrograde ventriculararatrial refractory period. By using single atrial extra stimuli with decrement shortening of coupling interval in 10-ms steps during sinus rhythm starting from 600 ms down.

Determination the characteristic electro-physiological feature of of antegrade and retrograde AV conduction pathways at different cycle length. S1 500, S2 400 and S3 360ms basic drive cycle lengths and Incremental atrial and ventricular pacing.

After induction typical AVNRT, AH interval always checked in base line, before tachycardia and during tachycardia, we assess AH interval for AH jump by decreasing the cycle length interval in 10 ms step by step during the sinus rhythm, and to follow if there is Echo beat or not during that.

AH Jumping

Refer to one sudden increase in AH interval more than 50 ms, at first time after application of atrial programmed stimulation with shortened of cycle length in sinus rhythm 10ms decrements resulting in discontinuity in the atrioventricular conduction one time that in dual AV nodal pathway.

While multiple atrioventricular conduction pathways occurrence during programmed stimulation when more than one sudden increases in AH interval appear in same patients resulting in two or three discontinuities in the conduction.

Radiofrequency catheter ablation and Mapping

After collection of all EP data and measurement in typical AVNRT type of our study, Navistar 4 mm tip size catheter ablation was introduced with used of mapping 3D system to localized the His area with draw the Triangle of Koch and slow pathway area localization by conventional and mapping system. And depending on Anatomy the electrode of ablation catheter was placed in a posterior position, achieving a ratio between atria and ventricular potential of one to three folds which consider the area of slow pathway.

After that Radiofrequency applied with temperature of 60 C and Energy set with 30 to 35 W and time period of 60 s for each lesion.

Sign of successful ablation was appearance of accelerated junctional rhythms. And ablation stops after 20 second if no junctional rhythms.

After ablation presence of anterograde slow pathway with or without AV node echo beat not consider as failure of ablation. So the end point of ablation Non inducibility of the arrhythmia and it is accepted endpoint as good indicator with successful ablation (AVNRT) [8].

Results

Electrophysiological study was done in Fifty four patients with typical type of AVNRTs and according to the result of AH measurement interval pre and post AVNRT induction. The patients were divided into two groups, those they have one jumping in the AH interval (G1) and G2 they have multiple jumping in the AH interval.G1 with dual AV nodal physiology and G2 with multiple AV nodal physiology. The age of the patients in this study ranging from 18-60 years and 14 patients (26%) were male and 40 patients (74%) were female.

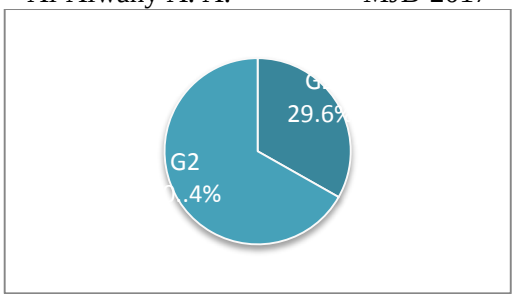

Figure 1: Percentage of pathway between two groups

That means the discontinuity of AV conduction curve was change with programmed stimulation by 10ms decrements in each atrial extr astimuli. In G1 the AH jump occur with one discontinuity in the curve and they were 38 patients (70.4%) while in G2 more the one discontinuity in the curve occur in 16 patients (29.6%).as in figure (2a and 2b), may be two or three.

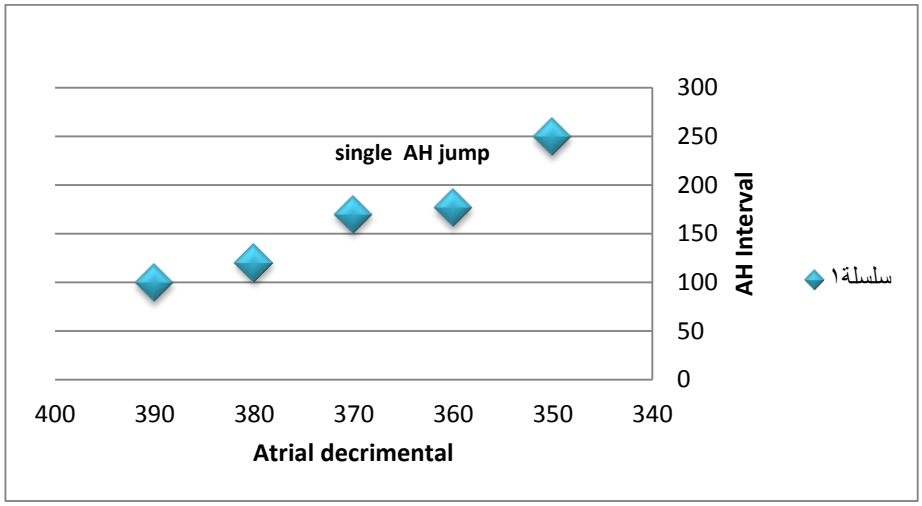

Figure 2 a: Single discontinuity in the AV conduction curve.

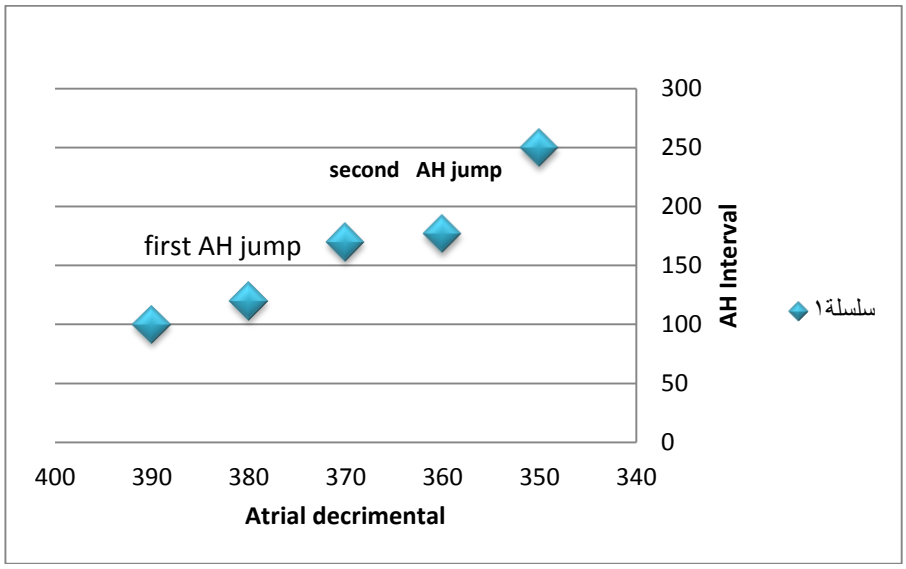

Figure 2 b: Multiple jumping in AV conduction curve

It was clear that typical AVNRTs occur in females patients more than males, in our study (14 (26 %) male versus 40 (74%) females), there is significance gender difference between male and female in all patients involved in this study. And between two groups female patients consider clinical significant difference value $P<0.05$ in compare to male

The cycle lengths of patients with double AV nodal pathways (345±65) seem to be faster than the cycle lengths of patients with multiple AV nodal pathways (410±70). So that mean the cycle lengths of typical AVNRT patients with multiple pathways were significantly longer compared with the other forms of typical AVNRT (*P*=0·043, Table 1)

Table 1: Demographic data between two groups clinical and electrophysiological

	G 1 (n=38)	G2 (n=16)	P. value
Age	38± 11.4	45± 12.6	0.073
Sex: male female	6 (11%) 30(55%)	8(15%) 10(19%)	0.64 0.026
Cycle length in ms	330 ±56	430±67	0.039
Nó of lesion	6.3± 3.2	12± 4.8	0.034
Block	0	0	
Duration of procedure (min)	71± 11.6	82 ± 12.4	0.067

Catheter ablation was applied in all patients in this study by using mapping and conventional system, after localization the His point with 3D mapping and comparing with anatomical approach, Energy delivered from power source and set with 35C® and 60 second for each lesion. Until good frequent Junctional rhythm appear in area of slow pathway. So in G1 to achieve successful ablation (6.3± 3.2) lesions were required while in G2 patients more lesion and energy delivered (12± 4.8) for successful ablation (*P*<0·05) (table 1).

In each patient after ablation re stimulation with same programmed and more aggressive with or without used of atropine to induced tachycardia if induced ablation again until non-inducibility that why some procedure longer than others. As time of procedure longer in G2 than G1.

Table (2), show in most of patients complete ablation was occur as Jump was disappeared in 37 (69%) (31(58%) patients G1 versus 6 (11%) patients G2). While modulation occur less commonly 17 patients (31%), (G1 7(13%) versus 10 (18%) G2).

Table 2: Ablation Versus Modulation in groups

	Complete Ablation	Slow pathway Modulation	Total	P value
G 1	31(58%)	7 (13%)	38 (70.4%)	0.021
G2	6 (11%)	10 (18%)	16 (29.6%)	0.056
Total	37 (69%)	17 (31%)	54(100%)	0.039

Discussion

Our data revealed that the percentage of multiple pathways with multiple jumping as more than one discontinuity in AV conduction curve was little pit higher than expected, the percentage were 29.6%, in Tai et al [9], were 5.2% and others study 40% [10].

Female gender seen to be more in our study which expected clinically as this

tachycardia most commonly occur in female. And male in G2 more in G1.

As a result of more than one discontinuity in G2, the tachycardia cycle length of those patients seen to be longer as heart rate less than of G1, that mainly because there is more than one pathway sharing the way of the tachycardia reentry circuit. So there is clear difference in electrophysiological data and clinical manifestation between high rate tachycardia and slow one [11, 12].

After induction, short time for analysis the electrophysiological data of the induced tachycardia ablation at area of slow pathway done for all patients in study until non inducibilty with good success rate was achieve that consider as end point of procedure corresponding to all previous data in the primary end point of ablation [8].

The rate of ablation was higher as complete ablation of slow was achieve in 69% of our patients in study comparing 31%, only modulation of slow pathway.

Patients of G1 have higher percentage of ablation than modulation (58% versus 13%) with clear significant as one pathway more liable for ablation than modulation. While in G1 modulation seen to be more than ablation because of more than one pathway (18% versus 11%). And in those patients with modulation explain why the time of procedure more G2 than G1, and why the number of lesion also more than G1 as the presence more than one pathway need more time to achieve ablation and as time increase the number of lesion or energy deliver also increase, also the target of doctors all of time to achieve ablation rather than modulation give as idea why time of modulation procedure longer.

AS we used mapping system to localized the his area before ablation there is no block recorded in our study in comparing to low risk of block When ablation performed conventionally [13] and that explain we do slow pathway ablation away from superior septum which the area of low risk injury to AV node as the data recorded previously [14].

Conclusion

In patient with typical AVNRTs there is percentage of multiple AV pathways 29.6%, and during EP procedure those need good interpretation, analysis of tachycardia after induction, pre +nd post ablation, and also they need more time and energy for elimination of slow pathway as well as the used of mapping system to localized the His area before ablation is of value to prevent AV nodal injury.

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