

Evaluation of the effect of radiofrequency catheter ablation on autonomic function in patients with atrioventricular nodal reentrant tachycardia by head-up tilt table test

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Abstract

Background: One of the recommended treatments for atrioventricular nodal reentrant tachycardia (AVNRT), is radiofrequency catheter ablation (RFCA). However, RFCA may affect the autonomic system. This study aims to evaluate the effect of RFCA on autonomic system in patients with PSVT by head-up tilt table (HUTT) test.

Materials and Methods: In a before–after study, 22 patients with PSVT were enrolled. Data were collected with a data collection form that included two parts. Electrocardiogram (ECG), echocardiogram, 24-h Holter monitoring, HUTT test, heart rate variability (HRV) indexes, and symptoms of all patients were recorded 24 h before and 1 month after the ablation. Wilcoxon, McNemar, Mann–Whitney U, and Chi-square tests were used to analyze the data.

Results: Of the total 22 patients, 31.8% were male and 68.2% were female. There were significant differences in heart palpitation ($P < 0.0001$) and non-specific symptoms ($P = 0.031$) and no significant difference in head-up tilt test results and HRV indices before and after RFCA. The results showed that there were no significant differences in specific and non-specific symptoms in patients with AVNRT with positive and negative HUTT before and after RFCA.

Conclusions: The observed difference in heart palpitation and non-specific symptoms emphasized the role of AVNRT in causing these symptoms. Autonomic dysfunction is more probably an accompanying condition of AVNRT than causing symptoms. We could not find any significance in the results of HUTT after RFCA. HUTT cannot determine or predict the symptoms after RFCA.

Key Words: Atrioventricular nodal reentrant tachycardia, autonomic dysfunction, head-up tilt table test, HRV index, radiofrequency catheter ablation

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INTRODUCTION

One of the recommended treatments for atrioventricular nodal reentrant tachycardia (AVNRT) and accessory atrioventricular (AV) connection is radiofrequency catheter ablation (RFCA).^[1-5] The therapeutic approach is safe, effective, and affordable.^[6] However, RFCA may cause changes in the autonomic nervous system such

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as variation in heart rate (HR) and its dysfunction.^[7] A decreased heart rate variability (HRV) has been reported by some studies using the technique of HRV analysis in time and frequency to investigate such disturbances.^[1,7] Also, dramatic increase in sinus rate, accompanied by an impressive decrease in HRV has been reported in some patients. Several articles reported that the cause of increase in sinus rate and reduction of HRV is predominantly debilitation of parasympathetic tone rather than increase in sympathetic tone.^[8] Some studies reported that inappropriate sinus tachycardia has been observed after RFCA as a result of parasympathetic nervous damage.^[7,9-11] Disturbance in the sympathetic or parasympathetic nervous system causes neurally mediated syncope as a result of bradycardia and hypotension.^[12-14] To diagnose neurally mediated syncope, head-up tilt testing is used and to evaluate autonomic nervous activity in cardiovascular disease, frequency-domain analysis of electrocardiographic RR variations is performed.^[15-19] This study aims to evaluate the effect of RFCA on autonomic system in patients with PSVT by head-up tilt table (HUTT) test.

MATERIALS AND METHODS

In a before–after study, 22 patients with PSVT were enrolled. This study was approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences and informed consent was taken from all patients. Patient with previous RFCA, hypertension, diabetes, thyroid diseases, structural heart disease, or ear nose throat (ENT) problems, and psychological and neurological patients were excluded from the study. One week before RFCA, all the medication, including beta blockers, calcium channel blockers, digoxin, and other antiarrhythmic drugs, were discontinued. Electrocardiogram (ECG), echocardiogram, laboratory tests, 24-h monitoring of heart rhythms, and HUTT test were performed before RFCA. Also, patients aged more than 35 years with suspected coronary artery disease (CAD) were assessed for ischemic heart disease (IHD) by exercise test and angiography. The investigations were repeated 1 month after RFCA. To perform electrophysiology study (EPS), four quadripolar electrode 6 Fr catheters were inserted percutaneously via the femoral and subclavian veins and positioned consecutively in the upper right atrium, His bundle, apex of the right ventricle, and coronary sinus. Mapping and RFCA with a 7 Fr quadripolar electrode, 4 mm tip catheter (IBI-1500T8) was done. Data were collected using a data collection form that included two parts. The first part consisted of demographic data, data on ejection fraction (EF) and underlying diseases such as diabetes, thyroid diseases, neurological problems

and their drugs. The second part consisted of data on Holter monitoring, HUTT test, specific symptoms including syncope, presyncope, heart palpitation, shortness of breath, and chest pain, and non-specific symptoms including fatigue, tingling in hands and feet, weakness, and drowsiness. These were collected 24 h before RFCA and 1 month after RFCA. All the procedures of RFCA were done by an expert electrophysiologist to prevent inter-examiner bias. Data were analyzed using SPSS (V. 15). Wilcoxon, McNemar, Mann–Whitney U, and Chi-square tests were used to analyze the data.

RESULTS

Out of 22 patients, 7 (31.8%) were male and 15 (68.2%) were female. The mean age of the patients was 49.5 ± 14.5 years. Mean EF was $55 \pm 2.67\%$, with a range of 50-60%. There were significant differences in heart palpitation ($P < 0.0001$) and non-specific symptoms ($P = 0.031$), and there was no significant difference in head-up tilt test results before and after RFCA [Table 1].

There were no significant differences in the mean of standard deviation of NN intervals (SDNN), standard deviation of the average NN intervals (SDANN), and average of HR before and after RFCA in patients with AVNRT [Table 2].

Table 1: Specific symptoms, non-specific symptoms, and head-up tilt test in patients with AVNRT before and after RFCA

Variables	RFCA		P value
	Before	After	
Syncope			N/A
Yes	0	0	
No	0	0	
Presyncope			1
Yes	1	0	
No	21	22	
Heart palpitation			<0.0001
Yes	22	4	
No	0	18	
Shortness of breath			-
Yes	0	0	
No	0	0	
Chest pain			0.625
Yes	3	1	
No	21	19	
Non-specific symptoms			0.031
Yes	8	2	
No	14	20	
Head-up tilt test			1
Positive	10	9	
Negative	12	13	

RFCA: Radiofrequency catheter ablation, AVNRT: Atrioventricular nodal reentrant tachycardia

The result of HUTT in seven patients with AVNRT before and after RFCA was positive. We found significant difference in heart palpitation in the seven patients (P value: 0.016). The result of HUTT in 10 patients with AVNRT before and after RFCA was negative. There was significant difference in heart palpitation in the 10 patients before and after RFCA ($P = 0.008$). But there were no significant differences in specific symptoms, non-specific symptoms, SDNN, SDANN, and average HR, maximum HR, and minimum HR in the 7 and 10 above-mentioned patients. The result of HUTT for three patients was positive before RFCA and negative after RFCA. Also, the result of HUTT for two patients was negative before RFCA and positive after RFCA. There were no significant differences in specific symptoms, non-specific symptoms, SDNN, SDANN, and average HR, maximum HR, and minimum HR in these patients [Table 3].

The result showed that there were no significant differences in specific and non-specific symptoms in patients with AVNRT with positive and negative HUTT before RFCA, and we did not find any significance in specific and non-specific symptoms in these patients with positive and negative HUTT after RFCA.

Table 2: SDNN, SDANN, average HR, max HR, and min HR in patients with AVNRT before and after RFCA

Variables	Mean	Standard deviation	P value
SDNN			0.974
Before	122.05	36.68	
After	119.86	28.95	
SDANN			0.935
Before	105.64	31.82	
After	104.18	29.6	
Average HR			0.837
Before	75.36	11.21	
After	76.18	10.99	
Max HR			0.889
Before	158.18	37.3	
After	160.77	35.63	
Min HR			0.758
Before	44.86	15.62	
After	42.86	15.76	

SDNN: Standard deviation of NN intervals, SDANN: Standard deviation of the average NN intervals, HR: Heart rate, Max: Maximum, Min: Minimum

Table 3: The results of head-up tilt test before and after RFCA in patients with AVNRT

Head-up tilt test	Before RFCA		After RFCA	
	Positive	Negative	Positive	Negative
Number of patients	7	10	7	10
	3	-	-	3
	-	2	2	-
Total	10	12	9	13

RFCA: Radiofrequency catheter ablation, AVNRT: Atrioventricular nodal reentrant tachycardia

DISCUSSION

In this study, we assessed the relationship between the symptoms (specific and non-specific) and the criteria of autonomic dysfunction in patients with AVNRT before and after RFCA using HUTT. The results showed that there was significant difference in heart palpitation before and after RFCA in patients with AVNRT ($P < 0.001$). Also, we found a significant difference in non-specific (fatigue, tingling in hands and feet, weakness, and drowsiness) symptoms. Seven (32%) patients had positive HUTT before and after RFCA. However, three of the patients had positive HUTT before RFCA and negative HUTT after RFCA. The cause of positive HUTT before RFCA was cardioinhibitor in 2 out of 10 patients, vasopressor in 7 of 10 patients, and mixed in 1 patient. Among these 10 patients, only 1 patient had positive HUTT after using nitroglycerin spray while the other 9 patients had positive HUTT without using nitroglycerin spray.

Other studies reported that autonomic dysfunction during AVNRT is influenced by induced position.^[20-22] The same incidence of syncope and presyncope symptoms in patients with negative and positive HUTT before RFCA, unlike the study of Doi,^[15] showed that HUTT before RFCA cannot predict the occurrence of syncope in patients with PSVT. However, further studies with larger sample size are needed. Ten patients had negative HUTT before and after RFCA, but two patients had negative HUTT before RFCA and positive HUTT after RFCA. Despite the high frequency of positive HUTT after RFCA, there was no significant difference in the frequency of symptoms between patients with positive and negative HUTT after RFCA. Probably, AVNRT is not alone a cause of autonomic dysfunction and symptoms in these patients because after treatment of these arrhythmias, we could not find any significant difference in the result of HUTT after RFCA. Also, due to the high positive HUTT was relatively common before RFCA (45%) in comparison with other studies (19-36%),^[23,24] it might be autonomic dysfunction is just accompanied by AVNRT and it has not had any role in creating symptoms after RFCA, but it can be considered as a cause of general symptom in these patients, which can be studied later. However, because of selecting patients in a serial manner for RFCA in the study, the entry bias should be considered to explain the relatively high incidence of positive HUTT.

Doi *et al.* reported that neglecting other tachyarrhythmias may be the cause of hemodynamic instability.^[15] The result of 24-h Holter monitoring

in the study showed that there were no significant differences in SDNN, SDANN, Max HR, Min HR, and mean HR before and after ablation, but some studies showed change in autonomic tone in patients with PSVT after HUTT.^[1,25,26]

Several studies reported alteration of autonomic tone by measuring HR and HRV.^[7,11,27,28] But other studies reported no significant changes.^[10,29,30] Kocovic *et al.* stated that the reason for change in autonomic tone and HRV is interruption of vagal fibers destined to innervate sinus node and after that parasympathetic withdrawal occurs.^[7] Unlike our results, Sehra could find significant difference in HRV (SDNN, SDANN) in children after RFCA, which may be due to the differences in age groups with our study population, but in their study the results of HUTT before RFCA were same in the groups. This indicates that autonomic dysfunction might not be related to arrhythmias before RFCA and the role of RFCA could be more important for the occurrence of autonomic dysfunction.^[31] Like in our study, Purerfellner *et al.* reported that RFCA of the slow pathway in AVNRT could not show significant difference in HRV index.^[30] Also, Emkanjoo *et al.* could not find any significant increase in SDNN.^[25] Markowitz *et al.* stated that autonomic disruption of vagal efferents is not the cause of acute changes in HR after posteroseptal ablation and change in autonomic tone is transitory. They showed that an increased HR due to the short-term withdrawal of parasympathetic tone is not related to direct injury to vagal efferent fibers. The procedural variables, including exposure to exogenous catecholamines, are more important because reinnervation makes HRV to normalize too early.^[32] The main strength of our study is collection of data 1 month after RFCA. Other studies measured HRV 1-2 days after RFCA.^[7,11,28] Low sample size could be a weakness of this study.

CONCLUSION

Recovery of heart palpitation and non-specific symptoms after ablation plays a significant role of AVNRT in creating these symptoms. No significant differences were found in the criteria of autonomic function and syncope and presyncope, indicating that autonomic dysfunction is more common as an accompanying factor and is related to AVNRT. We could not find any significant change in HUTT after RFCA, and HUTT could not determine and predict the symptoms after RFCA. Finally, we recommend further studies with larger sample size to evaluate the effect of RFCA on autonomic system in patients with PSVT by HUTT.

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