

RADIOFREQUENCY CATHETER ABLATION FOR THE MANAGEMENT OF PAROXYSMAL SUPRAVENTRICULAR TACHYCARDIAS: EXPERIENCE AT AFIC & NIHD

Muhammad Shabbir, Muhammad Irfan, Maham Zahid, Azmat Hayat, Syed Muhammad Imran Majeed

Armed Forces Institute of Cardiology & National Institute of Heart Diseases Rawalpindi, Pakistan

ABSTRACT

Objective: To share our experience of radiofrequency catheter ablation for the treatment of supraventricular cardiac arrhythmias at our institution

Study Design: Cross sectional study design.

Place and Duration of Study: The study was conducted at Armed Forces Institute of Cardiology & National Institute of Heart Diseases from January 2014 to January 2016

Material and Methods: In this retrospective single center study, 800 consecutive patients who underwent radiofrequency ablation were enrolled.

Results: In 536 of the 800 patients the supraventricular tachycardia substrate was an AVNRT (67%), in 236 patients an AVRT (29.5%) and in 28 patients an AT (3.5%). Supraventricular tachycardia was diagnosed 6.6 ± 12.1 years and ablated 8.5 ± 5.7 years after the first episode of tachycardia. The time interval between the first occurrence of the tachycardia and the diagnosis was significantly shorter in AVRT (p 0.03) as compared to AVNRT; however, the earlier diagnosis did not lead to earlier ablation. The total procedure duration, fluoroscopy time and number of RF energy applications for AVNRT were significantly shorter as compared to AVRT and AT (p 0.001). The overall success rate of radiofrequency ablation is calculated to be 97%. The complication rate at the time of ablation is reported to be 0.5%.

Conclusion: Radiofrequency catheter ablation has a good success rate and a low complication rate in patients suffering with supraventricular tachycardia.

Keywords: AVNRT, AVRT, AT, Radiofrequency ablation, Supraventricular tachycardia.

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INTRODUCTION

Paroxysmal supraventricular tachycardia (PSVT) is defined as a regular rapid heartbeat, which initiates and terminates suddenly. PSVT may have a variety of electrophysiologic mechanisms, including atrial tachycardia, atrioventricular (AV) nodal reentry, and tachycardia involving an accessory AV connection. Atrial tachycardia may be reentrant or may be caused by abnormal automaticity or triggered activity. AV nodal reentry, in which the reentrant circuit is confined to the AV node or the region around the AV node, is the most common type of PSVT in adults. Orthodromic supraventricular tachycardia is the most frequently found tachycardia in patients with

accessory AV connections. During orthodromic supraventricular tachycardia, antegrade conduction occurs via the AV node, and retrograde conduction occurs via an accessory AV connection¹. A definitive diagnosis of the PSVT mechanism usually requires cardiac electrophysiologic testing. Understanding the mechanism of PSVT can alter therapy because the response to antiarrhythmic drugs and efficacy of catheter ablation for curing PSVT may differ depending on the PSVT type².

Oftentimes, these specific PSVTs are difficult to treat medically due to therapy refractoriness and associated side effects, proarrhythmia, cost, and inconvenience. Therefore, radiofrequency catheter ablation is the recommended treatment in invasive cardiac electrophysiology due to its high primary success rate and low complication rate³. Catheter ablation can be defined as the use of

Correspondence: Dr Muhammad Shabbir, Consultant Cardiologist Fellow Electrophysiologist, AFIC/NIHD, Rawalpindi, Pakistan (Email:shabbir_1441@yahoo.com)

an electrode catheter to destroy small areas of myocardial tissue or conduction system, or both, that are critical to the initiation or maintenance of cardiac arrhythmias. Ablation of SVT targets specific electro-anatomical substrates which include the slow pathway in Atrioventricular Nodal Reentry Tachycardia (AVNRT), the accessory pathway in Atrioventricular Reentrant Tachycardia (AVRT) or an ectopic focus in Atrial Tachycardia (AT)³⁻⁶.

The purpose of this study is to share our experience regarding the indications, clinical characteristics of patients, procedural details,

MATERIAL AND METHODS

Patients

Two years retrospective data has been retrieved from Radiofrequency catheter ablation (RFCA) registry. From January 2014 to January 2016, 800 consecutive patients who underwent radiofrequency ablation for supraventricular tachycardias at our institution were enrolled in the study. Patients of both genders and all age groups were considered; who either had a typical history of a paroxysmal tachycardia or documented narrow complex SVT pattern in a twelve lead ECG. The

Table-1: Demographic and clinical characteristics of patients.

S.No	Variables	Study participants (N=800)	
		Male 452 (56.5%)	Females 348 (43.4%)
Demographic characteristics			
1.	Age (mean±SD)	38.5 ± 11.7 years	41.2 ± 13.9 years
2.	Weight (mean±SD)	68.4 ± 8.9 kg	59.1 ± 9.8 kg
3.	Height (mean±SD)	172 ± 12.3 cm	156 ± 14.1 cm
4.	BMI	22.5 ± 8.5	24 ± 7.1
Clinical characteristics			
5.	Co-morbid		
	Coronary artery disease	82 (18.1%)	54 (15.5%)
	Diabetes Mellitus	29 (6.4%)	31 (8.9%)
	Hypertension	37 (8.1%)	21 (6%)
	Kidney disease	14 (3%)	8 (2.3%)
6.	Symptoms		
	Paipitations	422 (93.3%)	297 (85.3%)
	Fatigue	247 (54.6%)	280 (80.4%)
	Chest pain	269 (59.5%)	170 (48.8%)
	Dyspnea	105 (13.1%)	124 (35.6%)
7.	NYHA class		
	NYHA class I	346 (76.5%)	225 (64.6%)
	NYHA class II	86 (19%)	101 (29%)
	NYHA class III	20 (4.4%)	22 (6.3%)
8.	LV Ejection fraction		
	Normal > 55%	414 (91.5%)	323 (92.8%)
	Mild 46-55%	27 (5.9%)	17 (4.8%)
	Moderate 31-45%	11 (2.4%)	8 (2.2%)

immediate outcomes and results of radiofrequency catheter ablation for the treatment of supraventricular cardiac arrhythmias at our institution.

study was approved by Institutional Ethical and Review Board (IERB).

Electrophysiology study and radiofrequency ablation

Catheter ablation procedure was performed in the cardiac catheterization laboratory, on either an inpatient or outpatient absorptive state and all antiarrhythmics were discontinued for at least five half-lives before the study. Two standard 6F quadripolar

Table-2: Classification of supraventricular tachycardia mechanisms.

S No.	Arrhythmia mechanism	Frequency & percentage
1.	AVNRT	536 (67%)
	• AVNRT (sf)	530
	• AVNRT (fs)	6
2.	AVRT	236 (29.5%)
	• Manifest Accessory pathway	
	• Right mid septal	10
	• Right posteroseptal	20
	• Right posterior	11
	• Right posteriolateral	15
	• Right lateral (freewall)	10
	• Right anterolateral	8
	• Left anterolateral	11
	• Left lateral (freewall)	25
	• Left posterolateral	18
	• Left posterior	19
	• Left posteroseptal	17
	• Concealed Accessory pathway	
	• Right mid septal	4
	• Right posteroseptal	6
	• Right anterolateral	8
	• Left anterior	4
	• Left anterolateral	8
	• Left lateral (freewall)	3
	• Left posterior	15
	• Left posterolateral	7
• Left posteroseptal	6	
• Left posteroseptal	11	
3.	Atrial Tachycardia	28 (3.5%)

Table-3: Procedural finding of patients according to supraventricular tachycardia substrates.

Variables	All patients (n=800) Mean ± sd	Avnrt (n=536) Mean ± sd	Avrt (n=236) Mean ± sd	At (n=28) Mean±sd	p-value
From symptoms to diagnosis (yrs)	6.6 ± 12.1	7.8 ± 15.9	5.4 ± 7.2	7.0 ± 8.1	0.03
From symptoms to ablation (yrs)	9.5 ± 5.7	10.1 ± 9.7	8.4 ± 6.3	7.9 ± 9.2	0.07
Procedure duration (mins)	101.7 ± 38.7	92.2 ± 30.6	121.3 ± 45.1	120 ± 59.5	0.001
Fluoroscopy time (mins)	22.8 ± 19.8	19.7 ± 20.1	36.7 ± 15.7	26.7 ± 21.7	0.03
RF applications (number)	8.3 ± 9.5	7.8 ± 8.3	10.6 ± 11.5	7.6 ± 6.9	0.008
RF applications time (number)	4.0 ± 3.7	2.9 ± 3.0	5.4 ± 4.6	2.6 ± 2.8	0.001
Power of RF energy (x10 ³ Ws)	7.3 ± 5.5	5.9 ± 5.6	10.3 ± 9.7	5.7 ± 6.8	0.001

basis. Patients received conscious sedation before and during the procedure. The patients underwent electrophysiology study in the post catheters were placed under fluoroscopy guidance via the right femoral vein in the right ventricular apex and at the bundle of His. One

7F quadripolar catheter placed in the right atrium, which was subsequently used as an ablation catheter. Another 7F quadripolar catheter was positioned in the coronary sinus via the left subclavian vein. Programmed atrial and ventricular stimulation was performed. Twelve lead surface ECG and bipolar filtered electrocardiograms (50 – 100 Hz) and unipolar unfiltered electrocardiograms were recorded (49.1 – 60.5 Hz). The exact mechanism of tachycardia was determined by electrophysiological study including induction and termination of tachycardia by atrial or ventricular extra-stimuli, presence of dual AV nodal physiology, parahisian pacing, retrograde conduction properties during ventricular pacing and advancement of the atrial electrogram after ventricular extra-stimulus delivered during His refractoriness. Successful ablation was defined as the non-reinducibility of the native tachycardia and the loss of the delta wave in manifest WPW syndrome. Subsequently, further electrophysiological testing for additional tachycardias, which could

Our analysis included all patients entering the electrophysiology laboratory for catheter ablation, regardless of whether ablation was performed. Continuous data were expressed as median and mean along with standard deviation values. Proportions were expressed as percentages with confidence intervals of 95%. Different groups were compared with either chi-square test or a non-parametric Fisher's exact test. Similarly groups of continuous variables were compared by using student's t-test or a non-parametric Wilcoxon - Mann - Whitney test.

RESULTS

During the 2 years period, 800 consecutive ablation procedures for paroxysmal SVT were performed. There were 452 (56.5%) males and 348 (43.4%) females. The age range was 16 – 77 years and mean age was 40.0 ± 15.3years. The mean age for males was 38.5 ± 11.7 years and 41.2 ± 13.9 years for females with a mean body weight of 68.4 ± 8.9 kg and 59.1 ± 9.8 kg respectively. There was a reasonable presentation of comorbidities, including

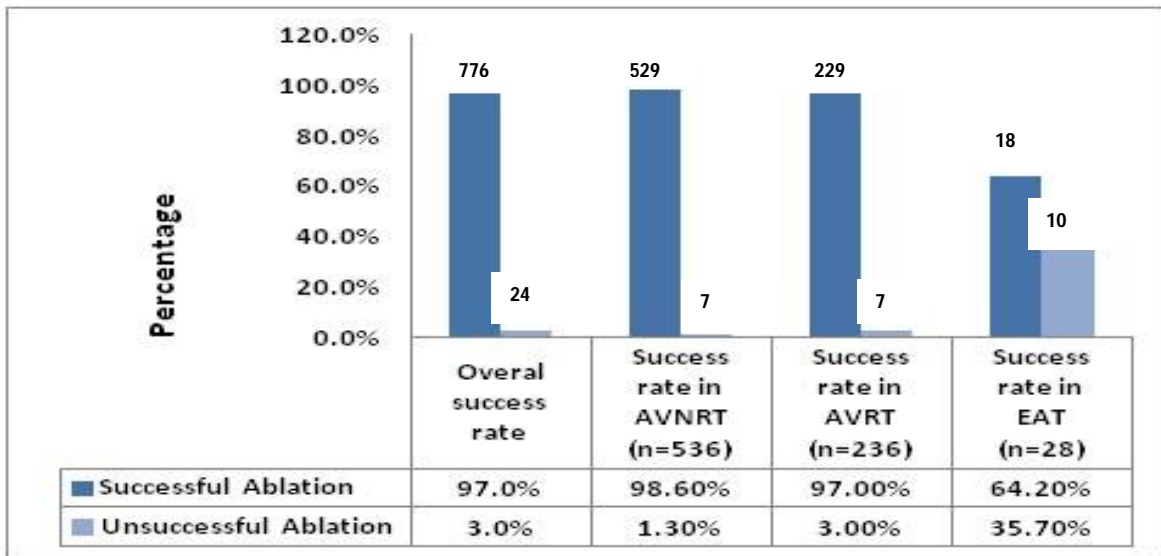


Figure:- Success rate of radiofrequency ablation.

potentially have been masked by the now ablated primary tachycardia, was performed. The aforementioned endpoints were repeatedly evaluated with isoprenaline infusion for 30 minutes after ablation.

Statistical Analysis

coronary artery disease (17%), diabetes (7.5%), hypertension (7.2%) and abnormal renal function (2.7%). The most common presenting complaints of PSVT included palpitations (89.8%), fatigue (65.8%), chest pain (54.8%) and dyspnea (28.6%). Demographic and basic

clinical characteristics of patients are shown in table-1

In 536 of the 800 patients the SVT substrate was an AVNRT (67%), in 236 patients an AVRT (29.5%) and in 28 patients an AT (3.5%) as shown in table-2. Significant difference was observed regarding the time interval between the first occurrence of tachycardia, its diagnosis and the year of ablation. SVT was diagnosed 6.6 ± 12.1 years and ablated 8.5 ± 5.7 years after the first episode of tachycardia. The time interval between the first occurrence of the tachycardia and the diagnosis was significantly shorter in AVRT ($p = 0.03$); however, the earlier diagnosis did not lead to earlier ablation. Procedural details including the total procedure duration, the number of RF energy applications, the fluoroscopy time, and the power of energy applications are summarized in table-3 for each substrate of SVT. There was a significant difference in the mean procedural time between patients with AVNRT and AVRT (92.2 ± 30.6 vs 121.3 ± 45.1 minutes, $p = 0.001$). Similarly, fluoroscopy time and number of RF energy applications in AVNRT were significantly shorter as compared to AVRT and AT ($p = 0.001$). 776 of 800 patients with SVT were successfully ablated and had no inducible arrhythmia after the ablation and had intact AV conduction. The overall success rate of radiofrequency ablation is calculated to be 97.3% as shown in figure 1. Success rate for AVNRT, AVRT and AT was calculated to be 98.6%, 97% and 64.2% respectively.

The complication rate at the time of ablation was 0.5%. Seven of the 380 patients had complications related to the ablation procedure. Transient AV block developed in 3 patients which was recovered later, while complete heart block occurred in 4 patients which required insertion of permanent pacemaker device. The rate was lowest for AVRT (0.84%) and highest for AVNRT (0.93%). After ablation, patients were followed for a median of 18 months (range, 12 to 24). Serial echocardiograms showed no damage to the valvular apparatus. No patient had recurrence of supraventricular tachycardia or any other type of arrhythmia on electrocardiography.

DISCUSSION

Radiofrequency ablation of AVNRT, AVRT and AT has become the first line therapy for patients with recurrent episodes of SVT. Acute and long term success with respect to primary electrophysiology outcome is well documented in literature⁷⁻¹¹. Likewise, results of our study show that catheter ablation is effective and safe treatment for PSVT. The most common substrate of SVT that required radiofrequency catheter ablation was AVNRT, followed by AVRT and AT. 800 patients were treated with radiofrequency catheter ablation and tachycardia could no longer be induced and AV conduction was preserved in 776 patients. The immediate success rate observed in our study is 97%. Success rate for AVNRT, AVRT and AT was calculated to be 98.6%, 97% and 64.2% respectively. According to various studies the success rate of catheter ablation ranges from 82 – 90%^{6,12,13}. It has also been reported that despite of successful ablation, new arrhythmia can arise in the long term and it can involve any pathway location and mechanism of tachycardia¹⁴.

Total time required to complete radiofrequency catheter ablation procedure is quite variable in various studies, but there is a general trend of shorter procedural duration for AVNRT as compared to AVRT¹⁵. Similar trend has been observed in our study with a significant difference in the mean procedural time between AVNRT and AVRT (92.2 ± 30.6 vs 121.3 ± 45.1 minutes, $p = 0.001$). Likewise, it is reported that a lesser number of radiofrequency energy applications are required for successful ablation of AVNRT as compared to AVRT¹⁶. Results of our study are also in line with these findings as a significantly lower number of radiofrequency energy applications have been recorded for AVNRT compared to AVRT (7.8 ± 8.3 vs 10.6 ± 11.5 minutes, $p = 0.008$). Literature shows a higher mean fluoroscopy time for AVRT ablation as compared to AVNRT, supporting results of our study where mean fluoroscopy time for AVRT is recorded to be 36.7 ± 15.7 minutes as compared to AVNRT 19.7 ± 20.1 minutes^{17,18}. Peri-procedural complication rates following radiofrequency ablation have ranged from 1% to 8% in some

studies. In our study, we had a lower complication rate which included heart block (0.5%) requiring insertion of permanent pacemaker¹⁹⁻²³.

CONCLUSION

Radiofrequency catheter ablation has a good success rate and a low complication rate in patients suffering with supraventricular tachycardia.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author

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