

RADIOFREQUENCY CATHETER ABLATION FOR SUPRAVENTRICULAR TACHYCARDIAS: EXPERIENCE AT PESHAWAR

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Background: Drug therapy is mostly employed in the management of supraventricular tachycardias (SVTs). However, radiofrequency catheter ablation has been found to be highly effective and safe in the treatment of SVTs. The current study is aimed at sharing our experience of 320 patients who presented with SVTs, and were treated with radiofrequency catheter ablation. **Methods:** This descriptive study was carried out in the Cardiac Electrophysiology Laboratory of Lady Reading Hospital, Peshawar from October 2006 to December 2009. Standard 4-wire electrophysiological study was carried out to identify the mechanism of SVT in 320 consecutive patients. Radiofrequency catheter ablation was used to interrupt the tachycardia circuit. **Results:** Out of a total 320 patients who underwent electrophysiologic study, 168 were found to have atrioventricular nodal re-entry as underlying mechanism; 121 patients were having accessory pathway responsible for re-entry (of these 95 presented with orthodromic reciprocating tachycardia and 26 as antidromic reciprocating tachycardia); 19 patients were having focal atrial tachycardia, 4 atrial fibrillation and 8 atrial flutter as the underlying cause for SVT. Radiofrequency catheter ablation was used with an overall success of 94% and a complication risk of complete AV block in 0.3% and recurrence rate of 3%. **Conclusion:** Radiofrequency catheter ablation is safe and highly effective mode of treatment of SVTs.

Keywords: Catheter ablation, Supraventricular tachycardia (SVT), Wolf Parkinson White (WPW) Syndrome

INTRODUCTION

In cardiology, our ability to cure is rare. When cardiac disease is diagnosed, most of our treatments are palliative. Complaints may be diminished and life prolonged, but the disease process will not be stopped. Cure, however, is possible in the patient suffering from a tachycardia in an otherwise normal heart. Supraventricular type of tachyarrhythmias (SVT) are a frequent cause of admissions to emergency room and mostly drug therapy is offered due to limited availability of electrophysiological (EP) services. In the past, occasionally surgery and even catheter based DC shocks have been used for drug refractory SVT.¹⁻⁴ By carrying out an EP study, we can locate the site of abnormal impulse formation or a critical part of the tachycardia pathway by cardiac activation mapping during the arrhythmia. By means of a catheter, radiofrequency (RF) energy can be applied to that area, resulting in destruction of a few mm of critical tissue and cure of the patient. This technique of EP/RFA has been with us now for over two decades. During this period, RFA has been found to be the first line of therapy for poorly tolerated SVT with hemodynamic intolerance or recurrent symptomatic SVT.^{3,5-7} The charm of this treatment modality is that most of the patients, once treated with EP/RFA, can have complete cure of their arrhythmia, and do not require any further drug therapy or follow-up.

The estimated prevalence of SVT is 3.5%.⁸ There are different forms of SVT; atrioventricular nodal re-entry (AVNRT) is the most common form accounting for approximately 60% of the cases, while 30% are atrioventricular tachycardia (AVRT), atrial tachycardia and atrial flutter constitute 10% of SVT.⁹

The first interventional catheter fulguration of an accessory pathway was performed by Weber and Schmitz in 1983.¹⁰ Since then, there has been lot of development to make ablation safer and now cryo-ablation has been proposed to be the safest for ablation targets close to sensitive structures like compact AN node.¹¹ The success rate of RFA depends upon the type of arrhythmia, however, it is more than 96% in atrioventricular nodal re-entry.¹²

Although several energy sources have been used for ablation, this article will deal only with ablation of SVT using RF energy.

MATERIAL AND METHODS

After obtaining informed consent, 320 consecutive patients with symptomatic drug resistant SVT were admitted from October 2006 to December 2009 in Hayatabad Medical Complex, Peshawar and underwent EP/RFA at the Cath Lab in Lady Reading Hospital, Peshawar. All antiarrhythmic drugs were discontinued at least three half lives of the respective drugs before the study except amiodarone, which was

withdrawn two months before study. Those with atrial fibrillation and age below 10 years were excluded. The study protocol was approved by the hospital ethical committee and patients were transferred to the lab in a fasting state having been sedated with diazepam or midazolam, while diamorphine or nalbuphin was given as analgesic. An intravenous bolus dose of Regular Heparin 2500 IU for right sided and 100 units/Kg for left sided procedures was routinely administered.

Four diagnostic EP catheters were introduced, 2 each through the right and left femoral veins and placed at the following sites; right atrial appendage (quadripolar 6-Fr catheter), right ventricular apex (quadripolar 6-Fr), His bundle region (Octopolar 6-Fr catheter) and Coronary sinus (CS) (decapolar 6-Fr catheter). A 7-Fr 4 mm ablation catheter was introduced through the right femoral vein. Left sided pathways were approached transeptally (via interatrial septal puncture) by using multipurpose 7-Fr sheath.

An indifferent patch was applied on back at left scapular area. Bard Pro EP Lab, Bloom stimulator and Cordis EP Shuttle were used to deliver radiofrequency current. Before inducing tachycardia, baseline intervals (PR, QRS, QT, AH, HV) were measured. The following parameters were looked for in all the tachycardias:

- Onset of tachycardia - with or without jump
- VA activation – concentric/eccentric
- VA interval – < or > 70 ms
- Parahisian Pacing response–Nodal or extra nodal
- Ventricular entrainment – post pacing interval < or > 115 ms
- VAV or VAAV response

The SVTs were grouped into four on the basis of initiating mechanism:

1. Atrioventricular nodal re-entry
2. Atrioventricular reciprocating tachycardia(Right or Left sided)
3. Atrial tachycardia (Right or Left sided)
4. Atrial flutter (Right or Left sided)

The right and left accessory pathways were further grouped into lateral, septal, anterior and posterior, parahisian and middle cardiac vein on the basis of their location.

For ablation in atrioventricular nodal re-entry, the RF energy was applied at anterior lip of CS os to modify the slow pathway. Mostly a power of 30 watts and a temperature of 60 °C energy was delivered for 60 Sec. The accessory pathways were modified by RF energy delivery at AV ring during sinus rhythm in manifest pathways or during tachycardia or ventricular pacing in orthodromic

tachycardias. The focal atrial tachycardias were targeted when atrial intracardiac electrogram on ablation catheter was 20–30 ms earlier than surface P wave. Isthmus dependent atrial flutters were managed by ablation line across isthmus from tricuspid valve to inferior vena cava.

Ablation was declared successful if no tachycardia could be induced after RFA even with isoproterenol.

RESULTS

Table-1 summarises the frequency of various types of SVTs among the patients who underwent RF ablation at our centre. The mean age of our patients was 38±19 years, with male to female ratio of 1:2.37. Two of our patients had rheumatic heart disease, six had coronary artery disease, and three pregnant patients were considered for RFA after a single documented episode of SVT because of the hemodynamic compromise during SVT. Only one patient (0.3%) with septal atrial tachycardia developed a major complication, i.e., complete heart block for which PPM was implanted; while minor complications like femoral artery aneurysm developed in only one patient (0.3%) and two patients (0.6%) developed right lower limb DVT two weeks post-procedure. Recurrence rate of 3% was observed in our patients.

Figure-1 shows how the pre-excitation pattern is lost on the surface ECG as soon as the accessory pathway is ablated. It is simultaneously visible in the intracardiac signals detected by the various catheters placed inside the heart at selective sites; there is fusion of AV signals which is lost after the pathway is ablated, and the AV signals become clearly separated from each other.

Figure-2 shows the frequency of the various SVTs we ablated at our centre, while Figure-3 shows their gender-wise distribution as well.

Table-1: SVT Catheter Ablation in our experience of 320 patients

Supraventricular tachycardia	Number	%
AVNRT	168	52.50
AVRT (ORT* =95, ART**=26)	121	37.81
Right-Sided Pathways	46	14.37
Middle cardiac vein	4	1.25
Parahisian pathway	2	0.62
Mahaim pathway	3	0.93
Left-sided pathways	66	20.62
Atrial fibrillation	4	1.25
Atrial flutter	8	2.50
Atrial tachycardia	19	5.93

*orthodromic tachycardia, **antidromic tachycardia



Figure-1: Top 4 tracings of surface ECG (leads I, II, aVF, V₁) show pre-excitation in the first two beats which is lost in the third beat after RF ablation. Tracings HRA 1, 2 to CS 1, 2 of intracardiac signals show fusion of AV signals in first two beats, while there is separation of AV signals in the last beat after ablation.

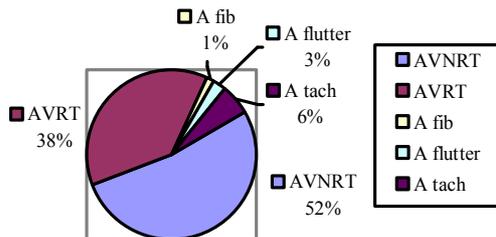


Figure-2: Frequency of the various SVT that have undergone EP/RFA at our centre

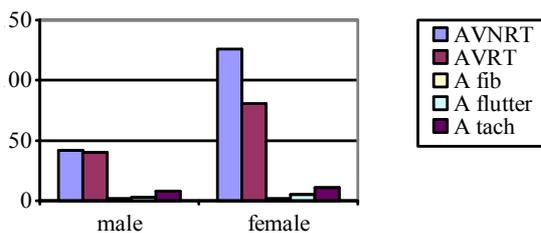


Figure-3: Gender-wise distribution of various SVTs that underwent ablation at our centre

DISCUSSION

Atrioventricular nodal re-entry is the most common cause of regular narrow complex SVT. In our study, 70% of SVT are due to atrioventricular nodal re-entry. If AVNRT are less frequent and responsive to therapy with beta blocker or Calcium channel blocker, then RFA can be deferred. However in patients with

frequent episodes or hemodynamic intolerance or those who refuse prolonged medication, RFA is a safe and cost effective treatment modality. The success rate is more than 96% and the risk of damaging the compact AV node is less than 1% especially with cryo-ablation and the recurrence rate is also less than 3%.^{13,14}

All of the patients we ablated for SVT were symptomatic despite drug therapy. Our recurrence rate in AVNRT has been very low because it had been part of our protocol to look for slow junctional rhythm during RFA and to reassure with Isoproterenol that tachycardia could no longer be reinduced once RFA had been done. The presence of a junctional rhythm during slow-pathway ablation has been indisputably considered to be the most sensitive but non-specific marker of successful ablation.¹⁵ Children under age of 10 years were not considered for the reason that radiofrequency ablation is not very safe in this age and cryo-ablation is a preferable option for AVNRT.¹⁶⁻¹⁸

The SVTs due to ORT and ART on the right side were mapped by ablation catheter in LAO 30° view. Those with evidence of ventricular pre-excitation on resting ECG were ablated in sinus rhythm targeting the closest AV site or the site having shortest delta-V wave and/or pathway potentials.¹⁹⁻²⁴ The RF energy was stopped if a pathway was not visualised in a 20 sec break. Also after successful ablation, a confirmatory burn for 60 sec at 50 watts was given in all cases to reduce the risk of recurrence. Amongst our 51 patients with left sided accessory pathways, 48 were approached transeptally in LAO 60° view while in only 3 patients,

ablation was done retrogradely via left ventricle; transeptal route was preferred because of the shorter procedure (average 20 min) and lesser radiation exposure. The transeptally approached patients were given Aspirin for 30 days after procedure to avoid any thromboembolic event.

The higher failure rate in atrial tachycardia was due to limitations of conventional EP catheters to provide adequate information about the electrical activity at the roof of right atrium.²⁵ 3-dimensional or non-contact mapping system is now the preferred approach for atrial tachycardia to have better results.

The success for isthmus dependent atrial flutter was 92%; the 8% failure can be attributed to lack of irrigated tip and 8 mm ablation catheter.²⁶

CONCLUSION

SVTs are mostly due to atrioventricular nodal re-entry or accessory pathways. RFA is a very safe and highly effective mode of treatment for SVT and should be considered as first line of therapy if EP services are available. Transeptal approach for left side accessory pathways is also very safe and less time consuming and avoids prolonged exposure to radiation associated with retrograde approach. For atrial tachycardia, the preferred approach is non-contact mapping. However, conventional approach of RFA can be considered for foci on the floor of the right atrium.

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