Outcome of Radiofrequency Catheter Ablation as a Non-Pharmacological Therapy for Idiopathic Ventricular Tachycardia

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ABSTRACT

Objective: To determine the outcome of Radiofrequency Catheter Ablation (RFCA) as a non-pharmacological curative therapy for idiopathic Ventricular Tachycardia (VT) and to identify procedure-related complications.

Study Design: Descriptive study.

Place and Duration of Study: The Armed Forces Institute of Cardiology and National Institute of Heart Diseases, Rawalpindi, from February 2001 to October 2008.

Methodology: Ninety eight consecutive patients with idiopathic VT, resistant to drug therapy, who underwent Electrophysiology Studies (EPS) radiofrequency catheter ablation were enrolled. Clinical and electrophysiological variables were recorded and a descriptive analysis was done.

Results: Out of the 98 patients, 79 were males (80.6%). The mean age was 33.29±11.93 years. Modes of presentation were sustained VT, Repetitive Monomorphic VT (RMVT), Non-sustained VT (NSVT) and Ventricular Premature Beats (VPBs). Right Ventricular Outflow Tract (RVOT) VT was found in 37 patients, 37 had Idiopathic Left Ventricular Tachycardia (ILVT), 20 had Left Ventricular Outflow Tract (LVOT) VT, and Inflow Right Ventricular Tachycardia (IRVT) was found in 7 patients. Other sites of origin of VT were infrequent. Eight patients had dual morphologies of VT. Atrioventricular Nodal Re-entry Tachycardia (AVNRT) was found in 8 patients. RFCA was successful in abolishing inducible VT in 88 patients. One patient developed complete AV block requiring a permanent pacemaker.

Conclusion: Results of this study confirm a high degree of success and safety of radiofrequency catheter ablation as curative therapy for idiopathic ventricular tachycardia.

Key words: Idiopathic ventricular tachycardia. Electrophysiology study. Radiofrequency catheter ablation.

INTRODUCTION

Idiopathic Ventricular Tachycardia (VT), by definition, occurs in structurally normal hearts. They account for approximately 10% of cases of ventricular tachycardia. Various sites of predilection are out-flow tracts, right more than the left and arising both from supra- and infravalvular locations. Another site of predilection is around the fascicles of the left ventricle, arising more commonly from posterior than anterior fascicle. Various therapeutic options for VT include antiarrhythmic drugs, antiarrhythmic surgery and placement of an Implantable Cardioverter Defibrillator (ICD), or radiofrequency catheter ablation. Drug therapy lacks complete symptomatic response and recurrence is common. Cardiac surgery for eradication or modification of cardiac arrhythmia substrate has been largely superceded by RFCA. ICD implantation is a corner stone therapy for ventricular tachyarrhythmia in patients with structural heart diseases. It is rarely required for idiopathic VT because these are largely considered curable by RFCA. Radiofrequency catheter ablation has become a promising procedure for the treatment of symptomatic idiopathic ventricular tachycardia over the past several years. Complications consequent upon RFCA are uncommon. However, there is a paucity of data on the efficacy and safety of radiofrequency catheter ablation amongst the local population.

The objectives of this study were to evaluate the outcome of RFCA as curative therapy for idiopathic VT and to identify procedure-related complications at the study centre.

METHODOLOGY

This descriptive case series was conducted at the Armed Forces Institute of Cardiology and the National Institute of Heart Diseases, Rawalpindi, from February 2001 to October 2008. Data was collected on a pre-designed proforma and purposive sampling was done. Patients who were referred to the cardiac electrophysiology department of AFIC from emergency reception and the outpatient department of AFIC and from local and peripheral hospitals with documented
episodes of ventricular tachycardia were evaluated and managed with appropriate drug therapy. Ninety eight consecutive patients with symptomatic idiopathic Ventricular Tachycardia (VT) despite medication, who underwent Electrophysiology Study (EPS) and Radiofrequency Catheter Ablation (RFCA) were included in this study.

All the patients underwent clinical evaluation with history and physical examination, followed by X-ray of the chest, urinalysis, complete blood picture and sugar, renal, hepatic and thyroid profiles. Serological tests for hepatitis B and C were also carried out. Patients were considered to have a structurally normal heart on the basis of a normal echocardiogram, normal resting ECG, no evidence of myocardial ischemia during exercise stress test and normal signal averaged ECG. Coronary angiography was carried out in all the patients who had VT of LV origin, and in those older than 40 years. A normal coronary angiogram was required as an inclusion criterion in these patients.

Informed written consent was obtained and an EP (electrophysiology) number was allotted to all the patients. The procedure was performed after a 4-hour pre-procedural fast. The femoral approach was used for placement of quadripolar electrode catheters, (Medtronic Bard, IBI, or Daig) under local anaesthesia, in the high right atrium, at upper reaches of the tricuspid valve for HIS bundle recording, and at the RV apex (Figure 1). A decapolar catheter was placed in the coronary sinus, via left subclavian vein approach. VT was induced, if not present spontaneously, by Programmed Electrical Stimulation (PES) using ventricular, and occasionally atrial extra-stimuli. In the event of successful termination of VT upon delivery of RF current, isoprenaline infusion was administered for half an hour followed by PES to demonstrate non-inducibility of VT. RFCA was considered successful, if there was neither spontaneous nor inducible VT. A record of clinical and procedural data was maintained.

Activation and pace mapping were used to identify the site of origin of VT. Either a 128-channel acquisition system (Cardio-Lab, Pruka Engineering, Houston, TX, USA) or Bard system were used for electrocardiography signal acquisition. NavX EnSite system (Endocardial Solutions Inc.) was used in some patients with right or left ventricular outflow tract origin VT.

A 4 mm tip RF catheter Marinr MC, Marinr MCXL or Conductr MC (Medtronic) was used for ablation. Where considered necessary by the operator, it was replaced by an 8 mm tip Conductr MC Catheter to achieve successful ablation. Catheter ablation was guided by earliest endocardial activation during VT, or by 12 out of 12 body surface 12 lead ECG match on pace mapping. RF energy was delivered with a maximum output at 50 W to achieve a temperature over 50°C. RF energy was delivered for at least one minute at successful ablation site.

Data was analyzed through the Statistical Package for Social Sciences (SPSS) version 10 for Windows. Means and standard deviation were calculated for age. Median and range were calculated for total procedure time, fluoroscopy time, radiation exposure, tachycardia cycle length and number of ablations. Frequencies and percentages were calculated for the type/site of origin of different VT substrates.

RESULTS

From February 2001 to October 2008, EPS and RFCA were performed in 98 patients of idiopathic ventricular tachycardia. The mean age was 33±11.93 years. There were 79 men (80.6%) and 19 women (19.4%). Sixty patients presented with sustained VT (61.2%), 14 with RMVT (14.3%), 13 with NSVT (13.3%), and 11 patients with VPBs (11.2%). The median tachycardia cycle length was 369.00 minutes, median total procedure time was 148.50 minutes, and median fluoroscopy time was 21.10 minutes (Table I). Radiation dose calculation was available in this record of 44 patients, the median of which was 102.50 Gy cm². The median of number of ablations was 9.00 (Table I).

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Right ventricular outflow tract ventricular tachycardia (RVOT VT) having LBBB like QRS morphology with inferior axis (Figure 2) and idiopathic left ventricular
tachycardia also known as fascicular VT (ILVT), electrocardiographically manifesting as RBBB like QRS morphology with left superior or right inferior axis (Figure 3) were the most frequent types. Left ventricular outflow tract ventricular tachycardia (LVOT VT) with S-wave in lead I, R-wave transition in V1 or V2 was the third most common variety. Outflow tract ventricular tachycardia had origin both from supra- (Figure 4) and infravalvular locations. RV inflow on the tricuspid valve and parahisian VT, bundle branch re-entry VT, basal inferoseptal, left ventricle free wall, LV apex and RV apex were the other sites of origin in this study population. Frequencies of various types and different sites of origin of VT are shown in Table II. More than one VT morphology from either or both ventricles was present in 8 patients. Successful termination of VT was recorded in 88 patients (89.8%). AVNRT was also inducible in 8 patients (8.2%) all being of the slow-fast type. These were also ablated with RFCA during the same session. None of the patients reported back with recurrence.

**DISCUSSION**

This series describes the data of 98 patients who had idiopathic ventricular tachycardia having 106 VT substrates. VT could be successfully ablated in 90% of the patients. This is consistent with experience at various centres around the globe, where success rates have been variously reported between 75-100%. RFCA successfully ablated VTs from several locations from both the left and right ventricles as had been described by Wu et al. The commonest VT of left ventricular origin was fascicular VT which was treated with RFCA, including VT from left posterior and anterior fascicles, as described by Ramprakash et al. Other left ventricular sites for the origin of VT were, outflow (supra- and infravalvular) tract including coronary sinus, left free wall and LV apex. Idiopathic left ventricular tachycardia (ILVT) also known as fascicular VT was found in 37; thirty three patients had ILVT alone and 4 patients had ILVT as a part of dual morphology. Such frequency of ILVT in this study may be because of the fact that there were a large number of male population from the armed forces.
Similarly, both supraventricular and subpulmonic VT from RVOT, RV inlet (on tricuspid valve and parahisian), basolinfereosental and RV apex were the different locations on right side from which VTs were successfully eliminated by RFCA as reported by Miller et al.15 Radiofrequency catheter ablation was relatively less effective in the VT of RVOT origin, where success was not achieved in 7 out of 37 in this study. Epicardial or deep intramycocardial location of the VT substrates was the main possibility of failure to ablate them from the endocardial approach.

RVOT VT was found in 37 (37.7%) patients, 28 of which arose from the subpulmonic area and 9 were PA VT. Tada et al. showed that PA-VT/PVCs were (4%) in their study population.16 There were 7 patients who had VT arising from RV inlet, 3 of them on the tricuspid valve and 4 were parahisian in this study population.

LVOT VTs including VT originating from the aortic sinus of valsalva represent under recognized VT entities, which are also amenable to successful catheter ablation.17 There were 20 patients who were found to have LVOT and 10 of them had sinus of valsalva VT (10.2 %) in this group of patients.

More than one VT substrate was demonstrated in 8 of the present patients. Both forms of the outflow tract VT may be found in the same patient as described by Srivathsan et al.1 and one of the present patients had VT from both RVOT and LVOT. Another patient also had two VT substrates, one in the LVOT and the other at LV apex. There was another patient having two VT substrates at the RV apex and LVOT, both of which were successfully cured during the same cession of RFCA ablation. Thus, we found more than one VT morphology in 8 of the patients (8.2%). Yash et al. had already demonstrated a second VT in 11% of patients during or after RF ablation of the "clinical" VT. The appearance of a second VT suggests either a different exit site of the same circuit or another site of origin.18 Kaseno et al. demonstrated dynamic QRS morphology changes following the RFCA, requiring additional RFCA applications at a different portion to abolish the OT-VT in 3.5% of the patients.19 Nine of the patients reported recurrence.

Topilski et al. demonstrated spontaneous or inducible Atrioventricular Nodal Re-entry Tachycardia (AVNRT) in 25% of the patients of idiopathic VT.20 Although the frequency of AVNRT was comparatively low, co-occidental AVNRT was found in 8 patients (8.2%).

Complications are distinctly uncommon. In this series there was one patient who had complete AV block during RFCA of the parahisian type of right ventricular tachycardia and required permanent pacemaker implantation. Many previous publications reported an absence of any major complications during catheter ablations of idiopathic VT with radiofrequency energy.8,9,10, 21 Magnetic resonance imaging could not be performed in the diagnosis of idiopathic VT to exclude the possibility of latent right ventricular dysplasia as an etiologic factor. However, conventional examinations were normal and no ventricular late potentials were detectable in this group of patients.

CONCLUSION

Results of the present study confirm the high degree of success and safety of radiofrequency catheter ablation for idiopathic ventricular tachycardia suggesting that this procedure can be used as first-line therapy for symptomatic drug-resistant patients. This modality of treatment is effective in idiopathic ventricular tachycardia arising from various locations from both the ventricles.

REFERENCES


