

Transvenous Radiofrequency Ablation Therapy in the Treatment of Arrhythmias: A Single Center Experience

Aritmilerin Tedavisinde Transvenöz Radyofrekans Ablasyon Tedavisi: Tek Merkez Deneyimi

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ABSTRACT

Introduction: Radiofrequency ablation of tachyarrhythmia is effective in the treatment of tachycardia. In this study, we evaluated the results of radiofrequency catheter ablation of tachyarrhythmia.

Patients and Methods: From December 2010 to January 2012, 114 consecutive patients with symptomatic drug-resistant typical slow-fast atrioventricular nodal reentrant tachycardia, 17 patients with atrioventricular reentrant tachycardia (five Wolf Parkinson White syndrome), eight patients with atrial tachycardia, seven patients with atrial flutter, five patients with right ventricular outflow tract tachycardia and three patients with atrial fibrillation underwent an invasive electrophysiology study and radiofrequency ablation.

Results: The 154 patients (age: 39.1 ± 17.2 years, body mass index: 24.3 ± 5.2 kg/m², waist/hip ratio: 0.88 ± 5.2 , systolic blood pressure: 128.3 ± 22.4 mmHg, diastolic blood pressure: 75.30 ± 9.0 mmHg, resting heart rate: 76.10 ± 8.2 beat/minute) with tachycardia (89 women, 65 men) were ablated. Procedure and fluoroscopy times were 57.5 ± 19.0 and 14.4 ± 4.1 minute respectively. The mean follow up period was 10.2 ± 4.3 months. During follow up period three patients with atrioventricular nodal reentrant tachycardia, two patients with atrioventricular reentrant tachycardia, one patient with right ventricular outflow tract tachycardia and one patient with atrial fibrillation had recurrence.

Conclusion: The transvenous radiofrequency ablation therapy is a safe and effective approach for the treatment of tachyarrhythmia under experienced hands.

Key Words: Catheter ablation, radiofrequency; ablation techniques; arrhythmias, cardiac.

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ÖZET

Giriş: Radyofrekans ablasyon taşiaritmilerin tedavisinde etkin bir yöntemdir. Bizler bu çalışmada taşikardilerin tedavisinde radyofrekans kateter ablasyonunun sonuçlarını araştırdık.

Hastalar ve Yöntem: Aralık 2010 ile Ocak 2012 tarihleri arasında invaziv elektrofizyolojik girişim ve radyofrekans kateter ablasyonu yapılan ardışık semptomatik olan ve ilaç tedavisine dirençli atriyoventriküler nodal reentrant taşikardili 114 hasta, atriyoventriküler reentrant taşikardili (AVRT) 17 hasta (beş Wolf Parkinson White sendrom), atriyal taşikardili sekiz hasta, atriyal flattırlı yedi hasta, sağ ventrikül çıkış yolu kaynaklı taşikardisi olan beş hasta ve atriyal fibrilasyonu olan üç hasta çalışmaya dahil edildi.

Bulgular: Taşikardisi olan 154 hastaya ablasyon tedavisi uygulandı (yaş: 39.1 ± 17.2 yıl, beden kitle indeksi: 24.3 ± 5.2 kg/m², bel/kalça oranı: 0.88 ± 5.2 , sistolik kan basıncı: 128.3 ± 22.4 mmHg, diyastolik kan basıncı: 75.30 ± 9.0 mmHg, dinlenme kalp hızı: 76.10 ± 8.2 beat/dakika, 89 kadın 65 erkek). İşlem ve floroskopi süreleri sırasıyla 57.5 ± 19.0 ve 14.4 ± 4.1 dakikaydı. Ortalama takip süresi 10.2 ± 4.3 aydı. Takip süresince atriyoventriküler nodal reentrant taşikardili üç, atriyoventriküler reentrant taşikardili iki, sağ ventrikül çıkış yolu taşikardili bir ve atriyal fibrilasyonlu bir hastada rekürrens gelişti.

Sonuç: Transvenöz radyofrekans ablasyon tedavisi deneyimli ellerde taşiaritmilerin tedavisi için güvenli ve etkin bir yöntemdir.

Anahtar Kelimeler: Radyofrekans, ablasyon, aritmi.

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INTRODUCTION

Radiofrequency (RF) catheter ablation is an important therapy in the management of patients with various types of tachyarrhythmia⁽¹⁻³⁾. It is proposed to be the first-line therapy for some arrhythmias and an important technique for others that are refractory to pharmacologic therapies. RF catheter ablation is commonly used in the treatment of atrioventricular reentrant tachycardia (AVRT) associated with the Wolf Parkinson White (WPW) syndrome or a concealed accessory pathway, atrioventricular nodal reentrant tachycardia (AVNRT), atrial tachycardia, atrial flutter, idiopathic ventricular tachycardia and bundle branch reentrant ventricular tachycardia, catheter ablation of the atrioventricular junction with permanent pacemaker implantation to establish rate control in refractory atrial fibrillation (AF), as adjunctive therapy for recurrent ventricular tachycardia due to coronary artery disease (CAD) or arrhythmogenic right ventricular cardiomyopathy.

The success rate is very high, ranging from 85-100% depending on the type of the arrhythmia⁽¹⁻³⁾. The recurrence rate is 2-8% and the complication rate is low⁽¹⁻³⁾. Among the complications, the late occurrence of complete heart block is an issue, especially in patients who have undergone slow pathway ablation for AVNRT, or ablation in the posteroseptal area⁽⁴⁻⁶⁾.

In this study, we reported our short and midterm results of RF catheter ablation of arrhythmias which is a safe, effective and reproducible strategy using RF energy.

PATIENTS and METHODS**Patients**

From December 2010 to January 2012, 114 consecutive patients with symptomatic drug-resistant typical slow-fast AVNRT, 17 patients with AVRT (five WPW syndrome), eight patients with atrial tachycardia, seven patients with atrial flutter, five patients with right ventricular outflow tract (RVOT) tachycardia and three patients with AF underwent an invasive electrophysiology study (EPS) and RF ablation. Ablation procedures were performed by experienced cardiologists after obtaining written informed consent. The investigation conforms to the principles outlined in the Declaration of Helsinki. A Vivid 5S cardiovascular ultrasound system [3S sector probe (1.5-3.6 MHz), GE] was used for transthoracic echocardiographic evaluation before ablation procedure. All measurements were made according to established standards⁽⁶⁾.

Electrophysiologic Study and Ablation Procedure

Electrophysiology study and RFA were performed according to the ACC/AHA guidelines⁽⁷⁾. All antiarrhythmic agents were stopped at least five days before the procedure. Amiodarone was used by six patients while the rhythm norm was by four patients and stopped 40 days before the procedure. Through femoral vein a 6F and two 7F catheters were introduced. Conventional quadripolar (JOS 6F), multi-directional (Marinr CS-7Fr) and bi-directional (St-Jude Sapphire) catheters were introduced into the right atrium across the tricuspid valve to record a right-sided His bundle

electrogram, the coronary sinus, and right ventricle. Bipolar electrograms were filtered at 30-500 Hz, amplified at gains of 20-80 mm/mV, and displayed and acquired on a physiological recorder (Cardiotek EP Tracer System, Holland), together with surface electrocardiograms. Programmed stimulation of the coronary sinus with 8 basic stimuli train and subsequent single, and afterwards double extrastimuli with gradually (10-ms step) shortened coupling interval, and incremental pacing protocols were performed. Typical AVNRT was diagnosed with 12 lead electrocardiography at emergency department settings or with 3 derivation 24 hour ambulatory electrocardiography. An increase of at least 50 ms in the AH interval for a 10 ms decrease in the atrial coupling interval was determined as AV nodal conduction jumps and indicated the persistent conduction over the slow pathway. The ablation catheter (RF Marinr MC-7Fr and St-Jude Sapphire-7Fr) was withdrawn inferiorly from the region of His Bundle along the atrial edge of tricuspid anulus. Both right and left anterior oblique projections were in localizing catheter at the slow pathway region. RF energy was delivered at energy of 35-55 Walt and temperature of 45-60°C up to 60 seconds. Basal and atropin and if unsuccessful dobutamin induced stimulation protocols were repeated after procedure to confirm the elimination of tachyarrhythmia. Patients were discharged within 24 hours after the procedure with only acetilsalicilic acid.

We located the sites of the accessory pathway (AP) around the atrioventricular annulus by mapping the shortest atrio-ventricular (AV) interval during sinus rhythm in manifest WPW syndrome and the shortest ventriculo-atrial (VA) interval during ventricular pacing or during AVRT. RF current was delivered at the site of shortest AV-VA during sinus rhythm or ventricular pacing respectively. Successful ablation was defined as either no inducible AVRT or loss of preexcitation.

Mapping of ectopic atrial tachycardia focus is performed during the tachycardia by moving the mapping-ablation catheter throughout multiple sites in the right atrium or left atrium (through patent foramen ovale or via transseptal puncture) under fluoroscopic guidance. The local atrial activation time is indexed against the onset of the P wave on the surface ECG to identify the likely site of the ectopic atrial tachycardia focus origin.

Pace mapping procedure involving the pacing from the ablation catheter during sinus rhythm in an attempt to match the QRS morphology during pacing with the QRS morphology on the surface ECG during the spontaneous

tachycardia was used to determine idiopathic right RVOT tachycardia. The ablation catheter is placed in the outflow tract and the tip is used to pace. A twelve lead ECG is recorded and compared to the surface QRS morphology during spontaneous ventricular tachycardia. Sites in which the pace map perfectly matches the spontaneous tachycardia complies with the origin of ventricular tachycardia and were ablated.

Type I atrial flutter, the wave front must proceed through the isthmus of tissue between the tricuspid annulus (TA) and inferior vena cava (IVC). Thus, ablation is directed largely fluoroscopically, with the goal of delivering a continuous series of RF lesions to create an ablation line of complete conduction block between the TA and IVC.

Ablation for AF focuses on the elimination of triggers for AF via electrical isolation of the pulmonary vein ostia from the body of the left atrium, and also includes additional lesions made in the body of the left atrium to modify arrhythmic substrate. RF ablation of AF was performed under the guidance of electroanatomic mapping with Ensite system.

Statistical Analysis

Statistical Software Package of SPSS version 13.0 was used for statistics analysis. All the values were expressed as mean \pm standard deviation. Mann-Whitney test was used to examine gender differences in measured antropometric and hemodynamic variables. Wilcoxon signed ranks test was used to examine pre-ablation and post-ablation AH interval. $p < 0.05$ was considered significant.

RESULTS

The 154 patients (age: 39.1 ± 17.2 years, body mass index: 24.3 ± 5.2 kg/m², waist/hip ratio: 0.88 ± 5.2 , systolic blood pressure: 128.3 ± 22.4 mmHg, diastolic blood pressure: 75.30 ± 9.0 mmHg, resting heart rate: 76.10 ± 8.2 beat/min) with tachycardia (89 women, 65 men) were ablated. AVNRT was induced during electrophysiological study. RFA successfully eliminated tachyarrhythmia in 114 patients with AVNRT (100%) patients at short term. Three patients had recurrence of AVNRT during follow up period and successfully reablated. The AH interval was decreased in the post-ablation period as compared with pre-ablation period ($p < 0.001$). Procedure and fluoroscopy times were 57.5 ± 19.0 and 14.4 ± 4.1 min respectively. A patient developed transient complete AV block and after the administration of 40 mg intravenous prednisolone it recovered in an hour.

Intravenous 5000 unit of unfractionated heparin administered to all patients. No hematoma, arterial laceration, femoral vein injury and atriovenous fistula formation was observed. All patients were mobilized one hour after the procedure. The mean discharge time was 12.3 ± 6.2 hours after the procedure. The mean follow up period was 10.2 ± 4.3 months.

In AVRT group, left sided APs represented the majority of cases (13/17, 76.5%), right sided APs were present in 4 (23.5%) patients. The detailed location of the APs is shown in Table 1. Two patients underwent re-ablation procedure due to recurrence.

Eight patients underwent RF ablation for atrial tachycardia. Ensite system was used in three of the procedures and remaining five procedures were performed with conventional method.

Seven patients underwent cavo-tricuspid anulus RF catheter ablation for typical atrial flutter.

RF ablation was performed to five patients with RVOT tachycardia. One patient had recurrent ventricular tachy-

cardia attack two months after the procedure and successfully re-ablated.

Catheter ablation of AF was performed to three patients under the guidance of Ensite system. Of the three patients two had permanent AF while one had paroxysmal AF. One patient developed cardiac tamponade after the procedure and one patient had recurrence of AF.

All patients had normal transthoracic echocardiography. Women had significantly increased body mass index, waist/hip ratio, resting heart rate compared to men. Age, systolic blood pressure and diastolic blood pressure were similar in men and women.

DISCUSSION

The anterograde conduction occurs through the slow pathway, while retrograde conduction occurs through the fast pathway in the typical AVNRT. The typical AVNRT can be treated with the RF ablation of the slow pathway⁽¹⁻⁵⁾. Both anatomic and electroanatomic approaches can be used effectively in RF ablation of AVNRT. The procedure may cause to the development of AV block in 1% of the patients⁽⁶⁾.

Rarely AV block of any degree, mostly transient and type-1, may occur after the slow pathway AVNRT ablation^(2,6). In our serie only a patient developed early transient Mobitz type-2 AV block after the procedure and recovered in an hour after the procedure. In this patient the His bundle was localized more laterally than expected and slow pathway was localized to near to the AV node. Prednisolone 40 mg intravenously was administered to the patient immediately as in most cases the block was due to the compression of AV node by edema formation secondary to cellular injury caused by RF energy. Thus after the resolution of inflammation and edema, AV block recovered. Hence steroids were used for their anti-inflammatory and anti-edematous properties. Very long preexisting PR interval, dual AV node physiology and the total elimination of slow pathway are predictors for the development of permanent AV block^(2,7,8). Lately cryotherapy ablation an expensive method was introduced for the prevention of the development of inadvertent AV block by testing the ablation site prior to producing permanent lesions⁽⁹⁾. Maintenance of dual AV node physiology and having residual conduction jumps are the important signs of recurrence. Patients were presented neither maintenance of dual AV physiology nor residual conduction jumps.

After an initially successful procedure, resolution of the inflammation or edema associated with the initial injury allows recurrence of accessory pathway conduction

Table 1. The characteristics of all patients

	Number
Atrioventricular nodal reentrant tachycardia	114
Atrioventricular reentrant tachycardia	17
Left lateral accessory pathway	6
Posteroseptal accessory pathway	4
Left posterior accessory pathway	2
Left lateral Wolf Parkinson White syndrome	4
Left posterior Wolf Parkinson White syndrome	1
Atrial tachycardia	8
Atrial flutter	7
Right ventricular outflow tract tachycardia	5
Atrial fibrillation	3
Age (years)	39.1 ± 17.2
Body mass index (kg/m ²)	24.3 ± 5.2
Systolic blood pressure (mmHg)	128.3 ± 22.4
Diastolic blood pressure (mmHg)	75.30 ± 9.0
Heart rate before ablation	76.10 ± 8.2
Fluoroscopy time (min)	14.4 ± 4.1
Procedure time (min)	57.5 ± 19.0
Follow up period (month)	10.2 ± 4.3
Women	89
Waist/hip ratio	0.88 ± 5.2

in approximately 5% of patients. We experienced two recurrences after first ablation but these two patients underwent successful reablation and achieved total cure. Accessory pathways that recur can usually be successfully ablated during a second session. Complications associated with catheter ablation of accessory pathways result from radiation exposure, vascular access (eg, hematomas, deep venous thrombosis, arterial perforation, arteriovenous fistula, pneumothorax), catheter manipulation (eg, valvular damage, microemboli, perforation of the coronary sinus or myocardial wall, coronary artery dissection, thrombosis), or delivery of RF energy (eg, AV block, myocardial perforation, coronary artery spasm or occlusion, transient ischemic attacks, cerebrovascular accidents^(2,10)). The procedure-related mortality reported for catheter ablation of accessory pathways ranges from 0 to 0.2%^(2,10). None of the patients with AVRT experienced any complication in our study.

Regardless of whether the arrhythmia is due to abnormal automaticity, triggering, or micro-re-entry, focal atrial tachycardia is ablated by targeting the site of origin of the atrial tachycardia. Electrograms at such sites are often fractionated and prolonged, and the activation time is generally 30 to 100 ms before the onset of the p wave. High-density mapping techniques using an electroanatomical map can facilitate successful ablation. Catheter ablation for focal atrial tachycardia showed an 86% success rate, with a recurrence rate of 8%^(2,11). Left atrial origins accounted for 18% of atrial tachycardias, and 10% of patients had multiple foci. The incidence of significant complications is low (1 to 2%) in experienced centers but includes cardiac perforation, damage to the right and left phrenic nerves, and sinus node dysfunction. Ablation of atrial tachycardia from the atrial septum or Koch's triangle may produce AV block. For patients with drug-refractory atrial tachycardia or incessant atrial tachycardia, especially when tachycardia-induced cardiomyopathy has developed, the best therapy is catheter ablation of the focus. Electroanatomic mapping by Ensite system was used in three patients and five patients underwent conventional catheter ablation. None of the patients experienced complication and recurrence.

Using more stringent criteria to prove the existence of bidirectional conduction block in the cavotricuspid isthmus results in better chronic success rates (90 to 100%)^(2,3). Quality of life was significantly improved in those treated with ablation.

Catheter ablation is promising method in the treatment of AF. Electroanatomic mapping systems provided increased success rates. Complete isolation of the pulmonary veins and/or the pulmonary vein antrum is required to achieve success for AF ablation procedures. We performed 3 AF RF ablation procedures under the guidance of Ensite mapping system. One patient developed cardiac tamponade after the procedure and one patient had recurrence at one month later the procedure.

CONCLUSION

In conclusion, the transvenous RF ablation therapy is a safe and effective approach for the treatment of tachyarrhythmia under experienced hands.

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CONFLICT of INTEREST

None declared.

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