Transvenous Radiofrequency Ablation Theraphy as an Effective and Safe Method for The Treatment of The Slow Pathway Of Atrioventricular Nodal Re-Entrant Tachycardia

Atriyoventriküler Nodal Re-Entran Taşikardide Yavaş Yolun Etkili ve Güvenilir Bir Metod Olan Transvenöz Radyofrekans İle Ablasyonu

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ABSTRACT

Background: The typical atrioventricular nodal re-entrant tachycardia (AVNRT) can be cured with the slow pathway ablation. In this study, we have analyzed a consecutive series of patients with typical AVNRT who underwent slow-pathway ablation which is a safe, effective and reproducible strategy using radiofrequency (RF) energy.

Patients and Method: Fifty consecutive patients with symptomatic drug-resistant typical (slow-fast) AVNRT underwent an invasive electrophysiology study and RF ablation (RFA) of slow conduction pathway within atrioventricular (AV) node. The endpoints of ablation were induction of a retrogradely conducted junctional rhythm, and non-inducibility of AVNRT on atropine.

Results: Fifty consecutive patients (age: 42.5 ± 15.4 years, body mass index: 25.56 ± 3.67 kg/m2, waist/hip ratio: 0.84 ± 7.164E-02, systolic blood pressure: 119.20 ± 13.57 mmHg, diastolic blood pressure: 74.40 ± 8.06 mmHg, rest heart rate: 76.20 ± 7.25 beat/min) with slow-fast AVNRT (40 women, 10 men) were ablated. AVNRT was induced during electrophysiological study. RFA successfully eliminated tachyarrhythmia in 50 (100%) patients. The AH interval was decreased in the post-ablation period as compared with pre-ablation period and no immediate conduction disturbances. Procedure and fluoroscopy times were 65.4 ± 19.0 and 13.4 ± 3.6 min respectively. No patient presented with AV block of any degree.

Conclusions: The transvenous radiofrequency ablation therapy is a safe and effective approach for AVNRT, but care should be taken to use it in a way with full understanding of its possibilities and limitations, otherwise it could lead to disappointing results.

Key Words: Tachycardia, Atrioventricular Nodal Reentry, Ablation Techniques, Atri-Oventricular Block.

ÖZET

Giriş: Tipik atriyoventriküler nodal re-entran taşikardi (AVNRT) yavaş yol ablasyonu ile tedavi edilebilir. Biz bu çalışmada radyofrekans (RF) enerjisini kullanan ve güvenli, etkili ve yeniden üretilebilir bir strateji olan yavaş yol ablasyonunu geçirmiş tipik AVNRT'li ardışık hasta serisini analiz ettik.

Hastalar ve Metod: Semptomatik ilaca dirençli tipik (yavaş-hızlı) AVNRT'li elli ardışık hastaya invaziv elektrofizyoloji çalışması ve atriyoventriküler (AV) içinde yavaş iletim yolunun RF ablasyonunu (RFA) yapıldı. Ablasyonun son noktaları retrograd iletimli kavşak ritminin uyarılması ve atropin üzerinden AVNRT'nin uyarılamaması idi.
Bulgular: Yavaş-hızlı AVNRT'li (40 kadın, 10 erkek) elli ardışık hasta (yaş: 42.5 ± 15.4 yıl, vücut kitle indeksi: 25.56 ± 3.67 kg/m2, bel/kalça oranı: 0.84 ± 7.164E-02, sistolik kan basıncı: 119.20 ± 13.57 mmHg, diyastolik kan basıncı: 74.40 ± 8.06 mmHg, istirahat kalp hızı: 76.20 ± 7.25 atım/dakika) ablate edildi. AVNRT elektrofizyolojik çalışma sırasında uyarıldı. RFA taşiaritmiyi 50 (%100) hastada başarıyla dışladı. AH aralığı pre-ablasyon periyotla kıyaslayınca post-ablasyon periyotta azaldı ve hızlı iletim bozukluğu yoktu. Prosedür ve floroskopi zamanları sırasıyla 65.4 ± 19.0 ve 13.4 ± 3.6 dakikaydı. Hastalar herhangi bir derecede AV bloğu göstermedi.
Sonuç: Transvenöz radyofrekans ablasyon tedavisi AVNRT için güvenli ve etkili bir yaklaşımdır, fakat kullanımı için olasılıklarını ve limitlerini tamamen anlayarak dikkatli olunmalıdır, aksi taktirde hayal kırıklığı ile sonuçlanabilir.
Anahtar Kelimeler: Taşikardi, Atrioventriküler Düğüm Yeniden Girişi, Ablasyon Teknikleri, Atriyoventriküler Blok.

INTRODUCTION

In the typical atrioventricular nodal re-entrant tachycardia (AVNRT), anterograde conduction occurs through the slow pathway, while retrograde conduction occurs through the fast pathway. This tachycardia can be cured with the slow pathway ablation (1-4). There are two approaches to slow pathway ablation. Generally, in the clinical practice, both anatomic and electroanatomic approaches used for slow-pathway ablation. Although the ablation of slow-pathway approach is effective, it may be associated with a 1% risk of AV block (5). In this study, we have analysed a consecutive series of patients with typical AVNRT who underwent slow-pathway ablation which is a safe, effective and reproducible strategy using radiofrequency (RF) energy.

PATIENTS AND METHOD

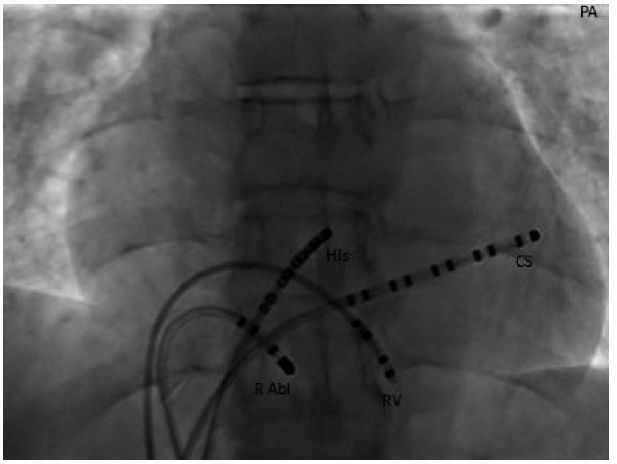
Patients

From December 2009 to December 2010, 50 consecutive patients with symptomatic drug-resistant typical slow-fast AVNRT underwent an invasive electrophysiology study (EPS) and RF ablation (RFA) of slow conduction pathway within atrioventricular (AV) node. All ablation procedures were performed by the same cardiologist and all patients provided written, informed consent. The investigation conforms with the principles outlined in the Declaration of Helsinki. A Vivid 3 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 previously described procedure (7). All antiarrhythmic agents had been discontinued for more than 3 days. No patient had received amiodarone. Conventional quadripolar (Jos 6F) and multi-polar (Marinr CS-7Fr) (for coronary sinus and His) catheter were introduced into the right atrium across the tricuspid valve to record a right-sided His bundle electrogram, the coronary sinus, and right ventricle (Figure 1-3).

Figure 1. *Position of the Ablation Catheter in the Postero-Anterior (PA) Projection. Note That the Ablating Catheter is Below the Ostium of the Coronary Sinus. CS: Coronary Sinus Catheter; His: His Bundle Catheter; R Abl: Radiofrequency Ablation Catheter, RV: Right Ventricle Catheter*



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. Two stimulation protocols were performed: 1) programmed stimulation of the coronary sinus with 8 basic stimuli train and subsequent single, and afterwards double extrastimuli with gradually (20-ms step) shortened coupling interval, and 2) incremental pacing protocol. Typical slow-fast AVNRT was diagnosed according to standard criteria (8). AV nodal conduction jumps were diagnosed using the criteria of an increase of at least 50 ms in the AH interval for a 10 ms decrease in the atrial coupling interval (Figure 4).

Demonstration of a conduction jump indicated persistent conduction over the slow pathway. The ablation catheter (RF Marinr MC-7Fr) is withdrawn inferiorly from the His bundle region along the atrial edge of the tricuspide annulus. Positioning of the catheter at the slow pathway region can be performed in either the left anterior oblique or right anterior oblique view (Figure 2,3).

Figure 2. *Position of the Ablation Catheter in the Left Anterior Oblique (LAO) projection. CS: Coronary Sinus Catheter; His: His Bundle Catheter; R Abl: Radiofrequency Ablation Catheter, RV: Right Ventricle Catheter*

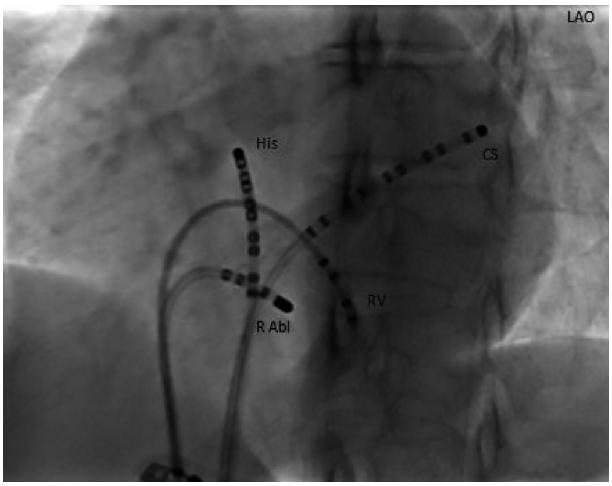


Figure 3. *Position of the Ablation Catheter in the Right Anterior Oblique (RAO) Projection. CS: Coronary Sinus Catheter; His: His Bundle Catheter; R Abl: Radiofrequency Ablation Catheter, RV: Right Ventricle Catheter*

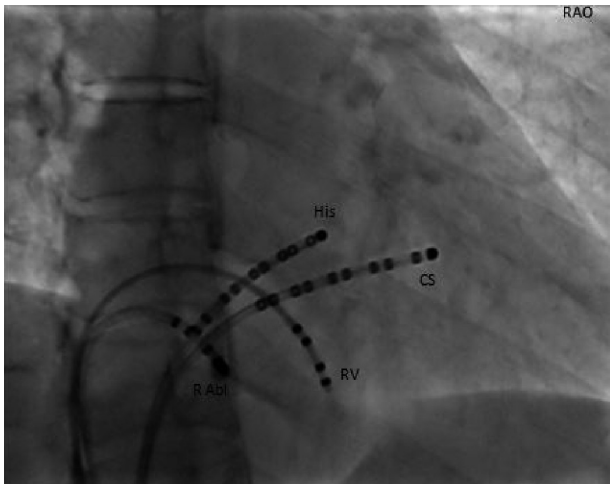
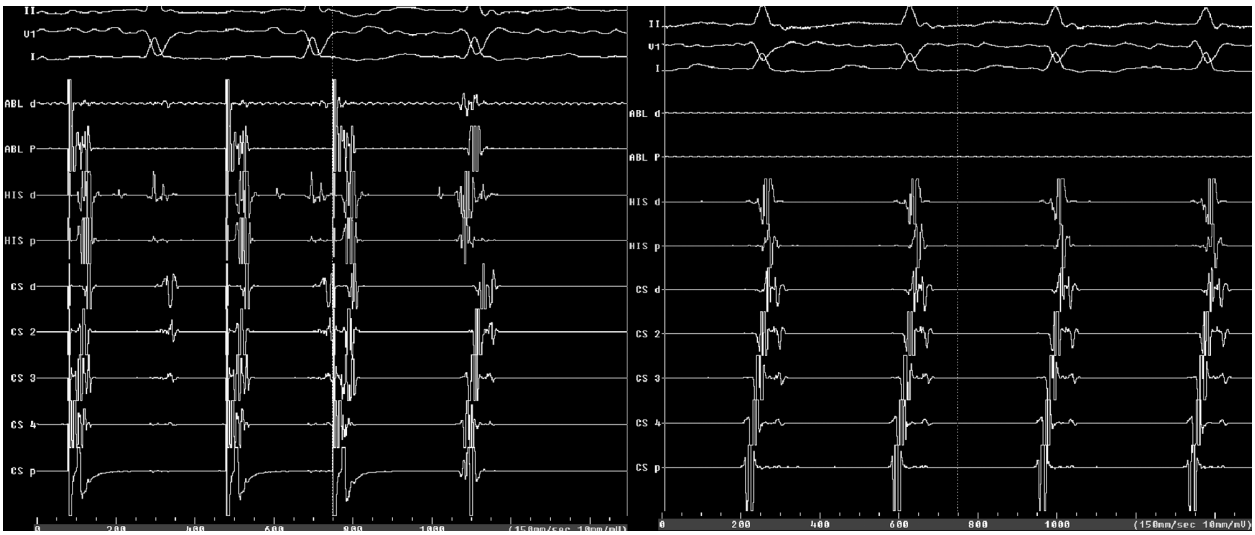


Figure 4. *Atrioventricular Nodal Conduction Jump and Atrioventricular Nodal Re-entrant Tachycardia (II, V1, I: Standard Surface ECG Leads, Abl: Ablation, His: His Bundle, CS: Coronary Sinus, d: Distal, p: Proximal)*



Radiofrequency energy was delivered at an energy of 30-50 W and temperature up to 50-60°C, for 60 s. Basal and atropin-induced stimulation protocols were repeated after ablation RF in order to stimulate AVNRT and to confirm elimination of tachyarrhythmia (Figure 5).

Following successful ablation, patients were discharged from hospital within 24 hours on aspirin and no antiarrhythmic drugs.

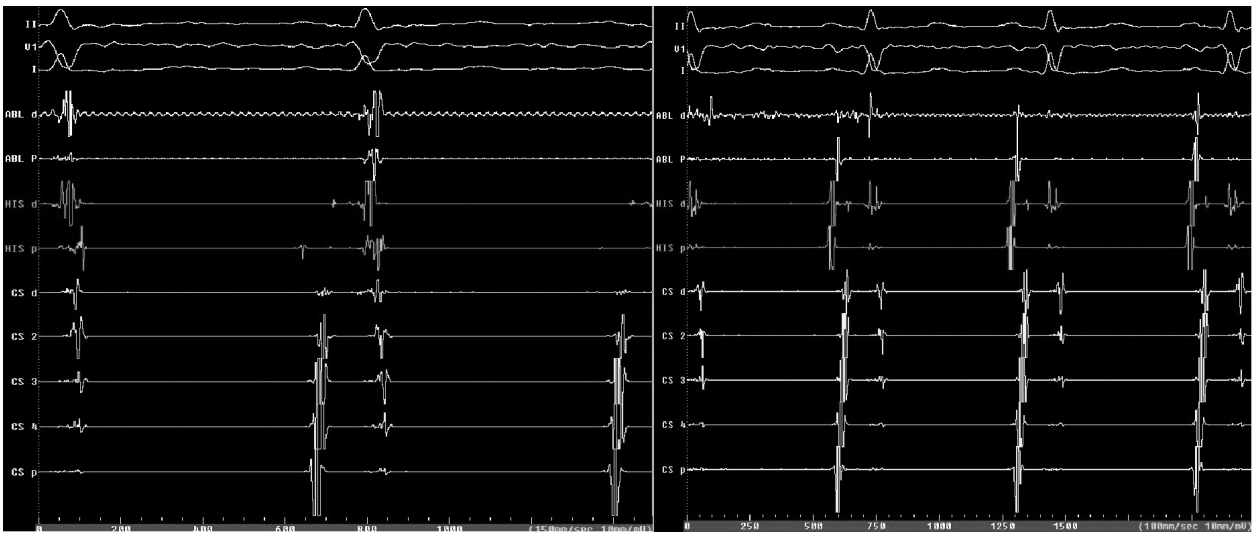
Statistical Analysis

Statistics were obtained using the Statistical Software Package of SPSS version 8.0. All the values were expressed as mean ± 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

Fifty consecutive patients [age: 42.5 ± 15.4 years, body mass index: 25.56 ± 3.67 kg/m2, waist/hip ratio: 0.84 ± 7.164E-02, systolic blood pressure: 119.20 ± 13.57 mmHg, diastolic blood pressure: 74.40 ± 8.06 mmHg, heart rate before ablation 76.20 ± 7.25 beat/min] with slow-fast AVNRT (40 women, 10 men) were ablated. All patients had normal left ventricular function (ejection fraction >50%), without evidence of underlying structural heart disease. By comparing the baseline characteristics between woman and man we didn't found any significance of age, body mass index, waist/hip ratio, systolic

Figure 5. *Intracardiac Electrocardigram During and the End of Radiofrequency Ablation (II, V1, I: Standard Surface ECG Leads, Abl: Ablation, His: His Bundle, CS: Coronary Sinus, d: Distal, p: Proximal)*



blood pressure, diastolic blood pressure and heart rate before ablation (Table 1). In all patients, AVNRT was induced during EPS. RFA successfully eliminated tachyarrhythmia in 50 (100%) patients. The AH interval was decreased in the post-ablation period as compared with pre-ablation period (Table 2) and no immediate conduction disturbances. Procedure and fluoroscopy times were 65.4 ± 19.0 and 13.4 ± 3.6 min respectively. In 3-month follow-up, one patient experienced recurrence of AVNRT episodes after 2 weeks of procedure. This patient had residual conduction jumps following ablation, although no tachycardia was inducible at that time. No patient presented with AV block of any degree.

DISCUSSION

Although the most important complication of slow pathway AVNRT ablation is AV block, it could be accomplished without any risk of AV block as was shown in this study. The risk of immediate AV block was 1% in some studies (5,9). In our series, no permanent complete AV block occurred during and after the ablation procedure. Total elimination of the slow pathway or having very long pre-existing PR intervals were suggested risk factors of permanent AV block (10,11). In these circumstances, retrograde fast pathway ablation especially when PR>300 ms or without evidence of the existence of antegrade fast pathway, nor dual AV node physiology was suggested by some authors (11,12). Percutaneous cryotherapy ablation of the slow pathway of AVNRT was demonstrated to be an effective method lately (13,14) which is an expensive method in compared to RF. Development of the inadvertent AV block may be prevented by testing the ablation site prior to producing permanent lesions. This technique may be beneficial especially in

Table 1. *Comparing the Baseline Characteristics Between Women and Men*

	Women (n=40) (Median, Min/Max)	Men (n=10) (Median, Min/Max)	
Age (years)	43.0 (17-76)	33.5 (19-51)	0.052
Body mass index (kg / m²)	26.00 (19-35)	24.00 (21-27)	0.076
Waist/hip ratio	0.83 (0.71-0.96)	0.83 (0.74-1.00)	0.855
Systolic blood pressure (mmHg)	120.00 (90-150)	110.00 (100-140)	0.084
Diastolic blood pressure (mmHg)	70.00 (60-90)	75.00 (60-90)	0.846
HR before ablation (beat/min)	75.50 (60-92)	76.00 (60-90)	0.824

HR: Heart Rate

Table 2. *The AH Interval in the Pre- and Post-Ablation Periods*

n=50	Pre-ablation period (Median, Min/Max)	Post-ablation period (Median, Min/Max)	p
AH interval (ms)	67 (57/69)	61 (53/65)	<0.001

patients with prolonged PR interval. Although opponent information was evident in some studies, maintenance of dual AV conduction physiology was showed as a predictor of recurrence. Only one of our patients had experienced the recurrence of AVNRT attack 2 weeks after the procedure. This patient had residual conduction jumps following ablation which is a sign of continuing dual physiology, although no tachycardia was inducible at that time. This failure was attributed to the close localization of the slow pathway to the His bundle and cryoablation therapy was suggested to the patient because of the development of AV block risk.

In Conclusion the transvenous radiofrequency ablation therapy is a safe and effective approach for AVNRT, but care should be taken to use it in a way with full understanding of its possibilities and limitations, otherwise it could lead to disappointing results.

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