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Assessment of The Relationship Between Waist Circumference As an Anthropometrical İndicator of Central Obesity and Fluoroscopic Exposure Time in Different Gender Patients Whom Underwent Radiofrequency Catheter Ablation Due to Antiarrhythmic Drug-refractory Tachycardia: A Multicenter Study

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ABSTRACT

Introduction: Radiofrequency catheter ablation therapy has been used to treat arrhythmia such as supraventricular and/or ventricular tachycardia. Increased waist circumference, is an important method to assess central obesity,which may also be an important factor for radiation injury. Therefore, this article describes the association between the waist circumference and fluoroscopic exposure time during cardiac radiofrequency catheter ablation procedures for symptomatic drug-resistant tachycardia.

Materials and Method: From August 2011 to March 2015, 214 (136 woman, 78 man) consecutive patients with symptomatic drug-resistant atrioventricular nodal re-entrant tachycardia (174 patient), atrioventricular re-entrant tachycardia (12 patient), Wolf Parkinson White syndrome (5 patient), atrial tachycardia (8 patient), atrial flutter (7 patient), right ventricular outflow tract tachycardia (5 patient) and atrial fibrillation (3 patient) underwent an invasive electrophysiological study and radiofrequency ablation were included to study. The fluoroscopic exposure time, radiofrequency ablation time and waist circumference were measured during electrophysiological study.

Results: Although age was significantly increased in women than men patient, body weight, body height, waist circumference and radiofrequency ablation time were significantly increased in men than woment. There was a correlation between waist circumference and flouroscopic exposure time ($p=0.04$, $r=0.13$).

Conclusion: The study showed that there was a positive correlation between the waist circumference and flouroscopic exposure time in patients with antiarrhythmic drug-refractory tachycardia underwent radiofrequency catheter ablation. This finding could be used to help prevent injury of radiation, especially increased waist circumference patients, during radiofrequency catheter ablation.

Keywords: Fluoroscopic exposure time and waist circumference

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Anti-Aritmik İlaçlara Dirençli Taşikardi Nedeni ile Radyofrekans Kateter Ablasyon Uygulanan Hastalarda Santral Obezitenin Antropometrik Bir Ölçütü Olarak Bel Çevresi Ile Floroskopi Maruziyet Süresi Arasındaki Ilişkinin Değerlendirilmesi: Çok Merkezli Çalışma

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ÖZET

Giriş: Radyofrekans kateter ablasyon tedavisi supraventriküler ve/veya ventriküler aritmilerin tedavisinde kullanılmaktadır. Artmış bel çevresi santral obeziteyi değerlendirmede önemli bir yöntemdir, aynı zamanda radyasyon hasarı için de önemli bir faktör olabilir. Bu nedenle bu makale semptomatik ilaca dirençli taşikardi nedeni ile yapılan kardiyak radyofrekans kateter ablasyonu sırasındaki floroskopi maruziyet süresi ile bel çevresi arasındaki ilişkiyi irdelemektedir.

Hastalar ve Metod: Ağustos 2011 ile mart 2015 arasında semptmatik ilaca dirençli; atriyoventriküler nodal re-entran taşikardi (174 hasta), atriyoventriküler re-entran taşikardi (12 hasta), Wolf Parkinson White sendromu (5 hasta), atriyal taşikardi (8 hasta), atriyal flutter (7 hasta), sağ ventriküler çıkış yolu taşikardisi (5 hasta), atriyal fibrilasyon (3 hasta) nedenleri ile invazif elektrofizyolojik çalışma ve radyofrekans ablasyon uygulanan 214 (136 kadın, 78 erkek) ardışık hasta çalışmaya dahil edildi. Floroskopi maruziyet süresi, radyofrekans ablasyon zamanı ve bel çevresi işlem sırasında ölçüldü.

Bulgular: Kadınların yaşı anlamlı olarak erkeklerden yüksek olsa da vücut ağrılığı, boy, bel çevresi ve radyofrekans ablasyon süresi erkeklerde kadınlara göre daha anlamlı olarak yüksekti. Bel çevresi ile floroskopi maruziyet süresi arasında bir korelasyon mevcuttu ($p=0.04$, $r=0.13$).

Sonuç: Çalışmamız göstermiştirki, anti aritmik ilaç dirençli taşikardi nedenli radyofrekans kateter ablasyon uygulanan hastalarda floroskopi maruziyet süresi ile bel çevresi arasında pozitif bir korelasyon mevcuttur. Bu bulgu özellikle artmış bel çevresi olan hastalarda radyofrekans kateter ablasyon sırasında radyasyon hasarını önlemek için faydalı olabilir.

Anahtar Kelimeler: Floroskopi maruziyet süresi, bel çevresi

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Introduction

Radiofrequency ablation that is done through a catheter to the targeted site such as cavotricuspid isthmus for atrial flutter, pulmonary veins for atrial fibrillation and accessory pathway is a transcatheter approach. Generally, fluoroscopy is used during radiofrequency catheter ablation such as ablation of atrioventricular nodal re-entrant tachycardia and atrioventricular re-entrant tachycardia (1). During flouroscopy, high doses of radiation may have the potential harmful effects on the body such as eyes and skin (2). Central obesity, an excess accumulation of fat in the abdominal area, is associated with metabolic syndrome and cardiovascular diseases. Waist circumference, is an important method to assess central obesity**,** has been shown to be one of the most accurate anthropometrical indicators of abdominal fat (3). Increased waist circumference and body mass index may be an important factor for injury of radiation (4-6). However, there have been very few reports describing the relationship between waist circumference and fluoroscopic exposure time during radiofrequency ablation procedures (4,5). Therefore, this article describes the association between the waist circumference and fluoroscopic exposure time during cardiac radiofrequency catheter ablation procedures for symptomatic drug-resistant tachycardia including atrioventricular nodal re-entrant tachycardia, atrioventricular re-entrant tachycardia, Wolf Parkinson White syndrome, atrial tachycardia, atrial flutter, right ventricular outflow tract tachycardia and atrial fibrillation.

Materials and Methods

Patients

From August 2011 to March 2015, 214 (136 woman, 78 man) consecutive patients with symptomatic drug-resistant atrioventricular nodal re-entrant tachycardia (174 patient), atrioventricular re-entrant tachycardia (12 patient), Wolf Parkinson White syndrome (5 patient), atrial tachycardia (8 patient), atrial flutter (7 patient), right ventricular outflow tract tachycardia (5 patient) and atrial fibrillation (3 patient) underwent an invasive electrophysiological study and radiofrequency ablation. All ablation procedures were performed by two cardiologist and all patients provided written, informed consent. The investigation conforms with the principles outlined in the Decleration of Helsinki. A Vivid 3 cardiovascular ultrasound system [3S sector probe (1.5-3.6 MHz), GE] was used for transthoracic echocardiographic evaluation including ejection fraction (%) before ablation procedure.

Body weight, height, waist circumference and hip circumference measurements

Weight of the patients were measured in kilograms as being in light clothes and without shoes and measurements of their height were taken. Waist circumference is measured between the last lib and crista iliaca on the midline while the patient was standing. Hip circumference is measured by using the line between right and left trochanter major of femur.

Blood pressure measurements

The arterial blood pressure was measured by the same observer in each subject in the supine position after at least 20 minutes of rest. Clinic blood pressure was measured, using a mercury sphygmomanometer with a cuff appropriate to the arm circumference (Korotkoff phase I for systolic blood pressure and V for diastolic blood pressure). In each subject two blood pressure measurement were performed, and their mean was considered for analysis.

Electrophysiological study and ablation procedure

Electrophysiological study and radiofrequency ablation were performed with a single-plane imaging system according to the ACC/AHA guidelines (1). All antiarrhythmic agents such as calcium channel blockers, beta blockers, propafenon had been discontinued for more than 5 days. No patient had received amiodarone. A detailed diagnostic study was performed in all patients prior to ablation to confirm the presence of the electrophysiological mechanism of tachycardia. The patient sample included patients with atrioventricular nodal re-entrant tachycardia, atrioventricular re-entrant tachycardia, Wolf Parkinson White syndrome, atrial tachycardia, atrial flutter, right ventricular outflow tract tachycardia and atrial fibrillation that required ablation of the atrioventricular node and/or other related area.

Ablation of atrioventricular nodal re-entrant tachycardia

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. 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 atrioventricular nodal re-entrant tachycardia was diagnosed according to standard criteria (8). Atrioventricular 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. 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. 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 radiofrequency ablation in order to stimulate atrioventricular nodal re-entrant tachycardia and to confirm elimination of tachyarrhythmia. Following successful ablation, patients were discharged from hospital within 24 hours on aspirin and no antiarrhythmic drugs.

Ablation of atrioventricular re-entrant tachycardia and Wolf Parkinson White syndrome

The sites of the accessory pathway was located around the atrioventricular annulus by mapping the shortest atrioventricular interval during sinus rhythm in manifest Wolf Parkinson White syndrome and the shortest ventriculoatrial interval during ventricular pacing or during atrioventricular re-entrant tachycardia. Radiofrequency energy was delivered at the site of shortest atrioventricular interval-ventriculoatrial interval during sinus rhythm or ventricular pacing, respectively. Successful ablation was defined as either no inducible atrioventricular re-entrant tachycardia or loss of preexcitation.

Ablation of atrial tachycardia

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 electrocardiography to identify the likely site of the ectopic atrial tachycardia focus origin.

Ablation of atrial flutter

Typically atrial flutter, the wave front must proceed through the isthmus of tissue between the tricuspid annulus and inferior vena cava. Thus, ablation is directed largely fluoroscopically,

with the goal of delivering a continuous series of radiofrequency lesions to create an ablation line of complete conduction block between the tricuspid annulus and inferior vena cava.

Ablation of atrial fibrillation

Ablation for atrial fibrillation focuses on the elimination of triggers for atrial fibrillation 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. Radiofrequency ablation of atrial fibrillation was performed under the guidance of electroanotomic mapping with Ensite system.

Ablation of right ventricular outflow tract tachycardia

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 electrocardiography during the spontaneous tachycardia was used to determine right ventricular outflow tract tachycardia. The ablation catheter is placed in the outflow tract and the tip is used to pace. A twelve lead electrocardiography 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.

Statistical analysis

Statistics were obtained using the ready-to-use programme of SPSS version 8.0. All the values were expressed as mean ± standard deviation. Student t test was used to examine gender differences in measured antropometric, hemodynamic and procedural (flouroscopic time, radiofrequenci ablation time) variables. Correlations were calculated with the Pearson test. $P<0.05$ was considered significant.

Results

Although the mean age was significantly higher in women, body weight, body height, waist circumference and radiofrequency ablation time were significantly higher in men compared to women (Table 1). Although there was a correlation between waist circumference and flouroscopic exposure time ($p=0.04$, $r=0.13$), gender ($p=0.03$, $r=0.14$), weight ($p<0.001$, $r=0.74$), height ($p=0.001$, $r=0.23$), hip ($p<0.001$, $r=0.61$), systolic blood pressure ($p<0.001$, $r=0.34$), and diastolic blood pressure ($p=0.02$, $r=0.15$), there was not any correlation between

waist circumference and age, heart rate and radiofrequency time (p=0.97, r=0.02; p=0.31, r=0.07; p=0.11, r=0.11; respectively). All patients had normal left ventricular function (ejection fraction >50%), without evidence of underlying structural heart disease. There was no radiation-induced skin and other tissue injury in our study. No patient presented with atrioventricular block of any degree.

Discussion

In this study, we showed that there was a positive correlation between the waist circumference and flouroscopic exposure time in patients who had antiarrhythmic drug-refractory tachycardia and underwent radiofrequency catheter ablation. Fluoroscopic exposure time is monitored during percutaneous interventions such as coronary and peripheral vascular interventions and radiofrequency catheter ablation such as ablation of atrioventricular re-entrant tachycardia and atrial fibrillation (6). During flouroscopy, the waist circumference may be an important factor for radiation injury (4,5), as shown in our study. To our knowledge, few studies have examined the correlation between fluoroscopic time and waist circumference in radiofrequency catheter ablation (4,5). Like all ionizing radiation that is composed of particles that individually carry enough energy to liberate an electron from an atom fluoroscopy is associated with increased risks such as skin damage, radiation cataract and radiation-induced cancer (2,7-10). From the biological effects of radiation on human body, radiation effects are generally divided into two groups: Deterministic effects and stochastic effects. Deterministic effects generally result from the receipt of a relatively high dose over a short time period. Skin erythema, infertility and radiation-induced cataract formation is an example of a deterministic effect. Stochastic effects, there is no threshold and the probability of having the effects is proportional to the dose absorbed, includes radiation-induced cancer and genetic defects. Currently, the fluoroscopy systems operate under automatic exposure control, with tube voltage and tube current adjusted to patient attenuation. Increasing tube potential during fluoroscopy procedure may result in significant organ radiation exposure among obese patients (5). Ector et al (4) demonstrated that the obese patients receive more than twice the effective radiation dose of normal-weight patients during ablation of atrial fibrillation procedures, as in our study. Also, Chida et al (6) examined the association between the maximum radiation skin dose and body weight, fluoroscopic time, and dose-area product. And, they found good correlations between the maximum radiation skin dose and fluoroscopic time and dose-area product in radiofrequency cathater ablation, as in our study.

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In conclusion, the study showed that there was a positive correlation between the waist circumference and flouroscopic exposure time in patients with antiarrhythmic drug-refractory tachycardia underwent radiofrequency catheter ablation. This finding could be used to help prevent injury of radiation during radiofrequency catheter ablation especially in patients with increased waist circumference.

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Table I: Comparing the baseline and procedural characteristics between woman and man

	Woman (n=136)	**Man (n=78)**	**P**
Age (years)	39.4±13.5	35.7±10.1	0.03
Weight (cm)	74.01±9.74	77.26±9.04	0.01
Height (cm)	164.39±7.63	173.42±7.00	<0.001
Waist circumference (cm)	83.84±10.00	86.81±8.78	0.03
Hip circumference (cm)	98.89±6.37	99.74±6.94	0.36
Systolic blood pressure (mmHg)	121.60±15.92	122.53±12.77	0.66
Diastolic blood pressure (mmHg)	76.52±7.59	77.40±7.81	0.42
HR before ablation (beat/min)	77.27±5.88	76.37±5.48	0.27
RF ablation time (sec)	82.20±27.77	94.74±31.74	0.003
Flouroscopic time (sec)	18.28±7.70	19.95±9.43	0.16

HR: Heart rate, RF: Radiofrequency ablation