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Assessment of the Relationship Between Waist Circumference as an Anthropometrical Indicator of Central Obesity and Fluoroscopic Exposure Time in Different Gender Patients Who 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 important in assessing central obesity and may be an important factor for radiation injury. Therefore, this article describes the association between waist circumference and fluoroscopic exposure time during cardiac radiofrequency catheter ablation procedures for symptomatic drug-resistant tachycardia.

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

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

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

Key Words: Fluoroscopic exposure time; waist circumference; gender differences; tachycardia; radiofrequency catheter ablation

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 İlişkinin Değerlendirilmesi: Çok Merkezli Çalışma

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 Yöntem: Ağustos 2011 ila Mart 2015 tarihleri arasında semptomatik 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

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yolu taşikardisi (5 hasta), atriyal fibrilasyon (3 hasta) nedenleri ile invaziv 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, antiaritmik 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

INTRODUCTION

Radiofrequency catheter ablation performed using a catheter to the targeted site, such as cavotricuspid isthmus for atrial flutter, pulmonary veins for atrial fibrillation, and accessory pathway, is inclued in transcatheter approach. Generally, fluoroscopy is used during radiofrequency catheter ablation procedures such as ablation of atrioventricular nodal re-entrant tachycardia and ablation of atrioventricular re-entrant tachycardia[1]. During fluoroscopy, high doses of radiation may have potential harmful effects on the body parts such as the 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 important in assessing central obesity and 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 important factors for radiation injury[4-6]. However, few reports have described the relationship between waist circumference and fluoroscopic exposure time during radiofrequency catheter ablation[4,5]. Therefore, this article describes the association between waist circumference and fluoroscopic exposure time during cardiac radiofrequency catheter ablation 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.

PATIENTS and METHODS

Patients

From August 2011 to March 2015, 214 (136 women, 78 men) consecutive patients with symptomatic drug-resistant atrioventricular nodal re-entrant tachycardia (174 patients), atrioventricular re-entrant tachycardia (12 patients), Wolf-Parkinson-White syndrome (5 patients), atrial tachycardia (8 patients), atrial flutter (7 patients), right ventricular outflow tract tachycardia (5 patients), and atrial fibrillation (3 patients) underwent an invasive electrophysiological study and radiofrequency catheter ablation. All ablation procedures were performed by two cardiologists and all patients provided written informed consent. The investigation conforms to 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 including ejection fraction (%) before ablation procedure.

Body Weight, Height, Waist Circumference, and Hip Circumference Measurements

Weights of patients were measured in kilograms while they were dressed in light clothes and without shoes; measurements of their heights were also taken. Waist circumference was measured between the last rib and crista iliaca on the midline while the patient was standing. Hip circumference is measured using the line between the right and left trochanter major of the 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 min of rest. Blood pressure was measured using a mercury sphygmomanometer with a cuff appropriate for the arm circumference (Korotkoff phase I for systolic blood pressure and V for diastolic blood pressure). In each subject, blood pressure measurement was performed twice, and their mean was considered for analysis.

Electrophysiological Study and Ablation Procedure

Electrophysiological study and radiofrequency catheter 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, and 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. 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 who required ablation of the atrioventricular node and/or other related areas.

Ablation of Atrioventricular Nodal Re-entrant Tachycardia

Conventional quadripolar (Jos 6F) and multi-polar (Marinr CS-7Fr) (for coronary sinus and His bundle) catheter were introduced into the right atrium across the tricuspid valve to record a right-sided His bundle electrogram, 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 using 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 followed by 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 the standard criteria[1]. 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 inferiorly withdrawn from the His bundle region along the atrial edge of the tricuspid 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 catheter ablation to stimulate atrioventricular nodal re-entrant tachycardia and confirm elimination of tachyarrhythmia. Following successful ablation, patients were discharged from hospital within 24 h on aspirin and no antiarrhythmic drugs.

Ablation of Atrioventricular Re-entrant Tachycardia and Wolf-Parkinson-White Syndrome

Sites of the accessory pathway were 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 the 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 or left atrium (through patent foramen ovale or via transseptal puncture) under fluoroscopic guidance. Local atrial activation time is indexed against the onset of the P wave on surface electrocardiography to identify the likely site of the ectopic atrial tachycardia focus origin.

Ablation of Atrial Flutter

Typically in atrial flutter, the wave front must proceed through the isthmus of the tissue between the tricuspid annulus and inferior vena cava. Thus, ablation is largely directed 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 catheter 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, 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 for pacing. A 12-lead electrocardiogram is recorded and compared to the surface QRS morphology during spontaneous ventricular tachycardia. Sites in which the pace map perfectly matches the spontaneous tachycardia comply with the origin of ventricular tachycardia and were ablated.

Statistical Analysis

Statistics were obtained using the ready-to-use programme SPSS version 8.0. All values were expressed as mean ± standard deviation. Student's t test was used to examine gender differences in measured antropometric, hemodynamic, and procedural (fluoroscopic time and radiofrequency ablation time) variables. Correlations were calculated using Pearson's test. $p< 0.05$ was considered statistically significant.

RESULTS

Although the mean age was significantly higher in women, body weight, body height, waist circumference and radiofrequency catheter ablation time were significantly higher in men (Table 1). Although there was a correlation between waist circumference and fluoroscopic 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 no correlation between waist circumference and age, heart rate, and radiofrequency catheter ablation 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.

Table 1. Comparing the baseline and procedural characteristics between women and men

	Women (n= 136)	Men (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 (s)	82.20 ± 27.77	94.74 ± 31.74	0.003
Fluoroscopic time (s)	18.28 ± 7.70	19.95 ± 9.43	0.16

HR: Heart rate, RF: Radiofrequency catheter ablation.

DISCUSSION

In this study, we showed that there was a positive correlation between waist circumference and fluoroscopic 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 fluoroscopy, waist circumference may be an important factor for radiation injury, as shown in our study.[4,5], To our knowledge, few studies have examined the correlation between fluoroscopic time and waist circumference in radiofrequency catheter ablation[4,5]. Similar to all ionizing radiation 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 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 are examples of a deterministic effect. In stochastic effects, there is no threshold and the probability of having the effects is proportional to the dose absorbed; examples include radiation-induced cancer and genetic defects. Currently, 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. demonstrated that obese patients receive more than twice the effective radiation dose received by normal-weight patients during ablation of atrial fibrillation procedures, as in our study[4]. Furthermore, Chida et al. examined the association between maximum radiation skin dose and body weight, fluoroscopic time, and dose–area product[6]. They also found good correlations between maximum radiation skin dose and fluoroscopic time and dose–area product in radiofrequency catheter ablation, as in our study.

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

CONFLICT of INTEREST

The authors reported no conflict of interest related to this article.

AUTHORSHIP CONTRIBUTIONS

Concept/Design: MY
Analysis/Interpretation: MY, AÇA, HİT
Data Acquisition: MY, AÇA, HİT, TG, SS, AŞ, İH
Writting: MY, AÇA
Critical Revision: MY, AÇA
Final Approval: All of authors

REFERENCES

1. Zipes DP, DiMarco JP, Gillette PC, Jackman WM, Myerburg RJ, Rahimtoola SH, et al. Guidelines for clinical intracardiac electrophysiological and catheter ablation procedures. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Clinical Intracardiac Electrophysiologic and Catheter Ablation Procedures), developed in collaboration with the North American Society of Pacing and Electrophysiology. J Am Coll Cardiol 1995;26:555-73.
2. McFadden SL, Mooney RB, Shepherd PH. X-ray dose and associated risks from radiofrequency catheter ablation procedures. Br J Radiol 2002;75:253-65.

3. Chan DC, Watts GF, Barrett PH, Burke V. Waist circumference, waist-to-hip ratio and body mass index as predictors of adipose tissue compartments in men. QJM 2003;96:441-7.
4. Ector J, Dragusin O, Adriaenssens B, Huybrechts W, Willems R, Ector H, et al. Obesity is a major determinant of radiation dose in patients undergoing pulmonary vein isolation for atrial fibrillation. J Am Coll Cardiol 2007;50:234-42.
5. Ding A, Mille MM, Liu T, Caracappa PF, Xu XG. Extension of RPI-adult male and female computational phantoms to obese patients and a Monte Carlo study of the effect on CT imaging dose. Phys Med Biol 2012;57:2441-59.
6. Chida K, Saito H, Otani H, Kohzuki M, Takahashi S, Yamada S, et al. Relationship between fluoroscopic time, dose-area product, body weight, and maximum radiation skin dose in cardiac interventional procedures. AJR Am J Roentgenol 2006;186:774-8.
7. Berlin L. Radiation-induced skin injuries and fluoroscopy. AJR Am J Roentgenol 2001;177:21-5.
8. Wagner LK, McNeese MD, Marx MV, Siegel EL. Severe skin reactions from interventional fluoroscopy: case report and review of the literature. Radiology 1999;213:773-6.
9. Brown KR, Rzucidlo E. Acute and chronic radiation injury. J Vasc Surg 2011;53(1 Suppl): S15-21.
10. Gerber TC, Carr JJ, Arai AE, Dixon RL, Ferrari VA, Gomes AS, et al. Ionizing radiation in cardiac imaging: a science advisory from the American Heart Association Committee on Cardiac Imaging of the Council on Clinical Cardiology and Committee on Cardiovascular Imaging and Intervention of the Council on Cardiovascular Radiology and Intervention. Circulation 2009;119:1056-65.