Kardiologia Polska
2010; 68, 8: 920–926

ISSN 0022–9032

Distribution of the Trp64Arg polymorphism in the β_3-adrenergic receptor gene in athletes and its influence on cardiovascular function

Sung Min Kim[1], Sang Duk Oh[1], In Geun Jung[1], Jin Lee[2], Young Je Sim[3], Jae Koo Lee[4], Byung Yong Kang[1]

[1]College of Physical Education, Hanyang University, Seoul, Korea
[2]Department of Anatomy and Cell Biology, The College of Medicine, Hanyang University, Seoul, Korea
[3]Department of Immunobiology, College of Human Sciences, Iowa State University, Ames, Iowa, USA
[4]Department of Leisure and Sports, Sahmyook University, Seoul, Korea

Abstract

Background: The Trp64Arg polymorphism in the β_3-adrenergic receptor (β_3-AR) gene was extensively studied concerning the relationship with cardiovascular (CV) diseases, but few studies addressed this issue in athletes.

Aim: To examine the relationship between the Trp64Arg polymorphism in the β_3-AR gene and several CV functions such as cardiac structure and function or blood biochemical parameters in Korean male controls and athletes.

Methods: We recruited a total of 114 study subjects, including 81 male athletes (8 long distance runners, 17 soccer, 8 baseball, 10 basketball, 8 volleyball, 8 ice hockey, 8 judo, 6 taekwondo and 8 gymnastics) and 33 controls. Two dimensional echocardiography was performed in order to assess the cardiac structure and function and blood biochemical parameters were measured. Genotyping of Trp64Arg polymorphism in the β_3-AR gene was also performed by the SNaPshot method.

Results: The genotype and allele distribution of Trp64Arg polymorphism in the β_3-AR gene were significantly different among each sporting discipline, showing the highest Arg allele frequency in volleyball and gymnastics ($p < 0.05$). Also, this polymorphism was significantly associated with serum HDL-cholesterol and glucose level in athletes only ($p < 0.05$).

Conclusions: Our data showed the significant associations between the Trp64Arg polymorphism in the β_3-AR gene and some CV parameters such as serum HDL-cholesterol and glucose levels in athletes. However, further studies of the precise mechanism behind these associations are needed.

Key words: athletes, β_3-adrenergic receptor and polymorphism

Kardiol Pol 2010; 68, 8: 920–926

INTRODUCTION

It is well known that multifactorial traits, such as physical fitness or physical performance, are determined by the complicated interaction between various genetic and environmental factors. With the advance in molecular biology, many investigators have attempted to investigate the genetic cause that influences such multifactorial traits, however the responsible gene has not been yet defined [1]. So far, among the candidate genes presumed influential in physical fitness or performance, the angiotensin I converting enzyme (ACE) gene has been most widely studied. However, the results are conflicting, and thus other candidates are needed to be studied [2].

Address for correspondence:
Byung Yong Kang, PhD, College of Physical Education, Hanyang University, 17 Haengdang-Dong, Seongdong-Gu, Seoul 133-791, Korea, tel: 82-2-3399-1692, fax: 82-2-3399-1464, e-mail: Kang1969@empal.com
Received: 19.01.2010 **Accepted:** 13.05.2010

Table 1. Demographic characteristics of study subjects

Variables	Controls (n = 33)	Athletes (n = 81)
Age [year]	22.2 ± 1.9	21.3 ± 1.2*
Height [cm]	181.0 ± 4.8	179.2 ± 8.5
Weight [kg]	73.6 ± 9.2	73.4 ± 10.5
BMI [kg/m^2]	22.4 ± 2.2	22.8 ± 2.7

*$p < 0.05$; BMI — body mass index

Physical fitness or performance is closely associated with cardiovascular (CV) function and energy metabolism. A certain gene encodes the β-adrenergic receptor (AR), which has emerged as a candidate that influences the physical performance [3]. The β-AR is linked to G-protein that uses catecholamines, such as epinephrine or norepinephrine, as ligand, and it is known that it has subtypes such as the β_1-AR, the β_2-AR and the β_3-AR [4]. In particular, the β_3-AR is distributed in brown adipose tissue and white adipose tissue. When it is stimulated by catecholamines, ligand, it activates the liked G_s-protein, by which adenylyl cyclase is activated and cyclic adenosine monophosphate, the second messenger, is increased and lipolysis and thermogenesis are promoted. Accordingly, it can increase basal metabolic rate and regulate the body temperature [5]. And it is known that β_3-AR in cardiac tissue controls cardiac contractility by lowering ventricular contractility and enhancing atrial contractility [6–8].

As stated above, given the fact that the β_3-AR are known to control not only the energy of metabolism, but also cardiac function, the gene that encodes this receptor is presumed to be a candidate that has the possibility to exert influence on physical performance and CV problems that occur in athletes. So far, there have been very few studies examining the distribution of β_3-AR gene polymorphism in athletes or the influence of β_3-AR gene polymorphism on the CV functions of athletes [9, 10]. This study aimed to examine the distribution of Trp64Arg polymorphism in the β_3-AR gene in athletes involved in various sport disciplines, and to ascertain whether this genetic polymorphism has a significant effect not merely on cardiac structure and function, but on the variables related to the CV function such as serum biochemical parameters.

METHODS

Study group

The study subjects included 81 athletes (8 long-distance runners, 17 soccer players, 8 baseball players, 10 basketball players, 8 volleyball players, 8 ice hockey players, 8 judo players, 6 taekwondo players, and 8 gymnasts) and 33 healthy control subjects (control group), 114 in all. All of them were in their late teens or early 20s, and were healthy males. Also, all athletes have the exercise carrier over at least 6 years as well as performing regular and specific training. Table 1 shows their physical traits. Written informed consent was obtained from all subjects, and this study was also approved by the institutional review board.

Physical measurement

The anthropological parameters of subjects were measured by use of IN-BODY 3.0 (Bio-Space Co., Ltd., Korea). Echocardiographic parameters, such as aortic root, left ventricular (LV) internal dimensions in end-diastole (LVIDD), LV internal dimension in end-systole (LVIDS), LV mass (LVM), LV mass index (LVMI), stroke volume (SV), resting heart rate (HR_{rest}), cardiac output (CO) and percent of fractional shortening (FS[%]), were measured by the use of M-mode echocardiography in accordance with the guideline of American Society of Echocardiography.

Genotyping

Three to five mL of whole blood was collected from 114 subjects, from which total genomic DNA was isolated. For the isolation of total genomic DNA, Miniban Automatic Blood DNA Isolation Kit (Bionex Co., Ltd. Korea) was used. By the use of the total genomic DNA isolated in that manner, Trp64Arg polymorphism of β_3-AR gene was analysed by the SNaPshot method.

Blood biochemical profiles

Blood samples were placed into the serum-isolating tubes. In the case of serum total cholesterol (TC), triglyceride, high density lipoprotein-cholesterol (HDL-C) concentrations were measured using enzyme treatment, colorimetry and ADVIA 1650 Autoanalyser. The concentration of serum low density lipoprotein-cholesterol (LDL-C) was calculated by use of the equation presented by Friedewald et al. (1972) [11]. The concentration of plasma glucose was determined by the use of enzyme treatment, colorimetry and Hitachi 7180 Autoanalyser.

Statistical analysis

The χ^2 test was used to examine whether there are any significant intergroup or inter-sport differences between the frequencies of alleles and genotypes that form the Trp64Arg polymorphism of β_3-AR gene, and whether the frequency of observed genotypes coincides with that expected by Hardy-Weinberg equilibrium.

Table 2. Distribution of the Trp64Arg polymorphism in the β_3-AR gene

	Controls	Athletes
Genotype		
Trp/Trp	25 (75.8%)	65 (80.2%)
Trp/Arg	8 (24.2%)	15 (18.5%)
Arg/Arg	0 (0.0%)	1 (1.2%)
Total	33 (100.0%)	81 (100.0%)
	χ^2 = 0.5356, df = 2, p = 0.7651	
Allele		
Trp	58 (87.9%)	145 (89.5%)
Arg	8 (12.1%)	17 (10.5%)
Total	66 (100.0%)	162 (100.0%)
	χ^2 = 0.0151, df = 1, p = 0.9021	

Table 3. Distribution of the Trp64Arg polymorphism in the β_3-AR gene by sporting disciplines

Disciplines	No.	Genotype No. (%)			Allele No. (%)	
		Trp/Trp	Trp/Arg	Arg/Arg	Trp	Arg
Runner	8	7 (87.5)	1 (12.5)	0 (0.0)	15 (93.7)	1 (6.3)
Soccer	17	14 (82.4)	3 (17.6)	0 (0.0)	31 (91.2)	3 (8.8)
Baseball	8	7 (87.5)	1 (12.5)	0 (0.0)	15 (93.7)	1 (6.3)
Basketball	10	9 (90.0)	1 (10.0)	0 (0.0)	19 (95.0)	1 (5.0)
Volleyball	8	4 (50.0)	3 (37.5)	1 (12.5)	11 (68.7)	5 (31.3)
Ice hockey	8	8 (100.0)	0 (0.0)	0 (0.0)	16 (100.0)	0 (0.0)
Judo	8	8 (100.0)	0 (0.0)	0 (0.0)	16 (100.0)	0 (0.0)
Taekwondo	6	5 (83.3)	1 (16.7)	0 (0.0)	11 (91.7)	1 (8.3)
Gymnastics	8	3 (37.5)	5 (62.5)	0 (0.0)	11 (68.7)	5 (31.3)
Athletes	81	65 (80.2)	15 (18.5)	1 (1.2)	145 (89.5)	17 (10.5)
Controls	33	25 (75.8)	8 (24.2)	0 (0.0)	58 (87.9)	8 (12.1)
Total	114	90 (78.9)	23 (20.2)	1 (0.9)	203 (89.0)	25 (11.0)
χ^2			29.9860		19.2214	
df			18		9	
p			0.0375		0.0234	

In order to asses whether three genotypes, which form the Trp64Arg polymorphism of β_3-AR gene, are significantly associated with echocardiographic data and serum biochemical parameters, subjects having Arg/Arg genotype or Trp/Arg genotype were compared with ones having Trp/Trp genotype in that Arg/Arg genotype indicated the lowest frequency among the three genotypes, and then the unpaired-t test was applied. A p value < 0.05 was significant. The SPSSWIN Program (version 17.0) was applied to statistical analysis.

RESULTS

Trp/Arg polymorphism in the β_3-AR gene

The distribution of genotypes, which form the Trp64Arg polymorphism of β_3-AR gene is shown in Table 2. The control group (χ^2 = 0.0160, df = 1, p = 0.8983), the athletic group (χ^2 = 0.1260, df = 1, p = 0.7222) and all the subjects (χ^2 = 0.0740, df = 1, p = 0.7863) met Hardy-Weinberg equilibrium criteria, however there were no significant differences in relation to genotypic frequency (χ^2 = 0.5356, df = 2, p = 0.7651) and allelic frequency (χ^2 = 0.0151, df = 1, p = 0.9021), respectively. Table 3 shows the frequency of genotypes, which form the Trp64Arg polymorphism of β_3-AR gene, and the distribution of allelic frequency in each sport. This genetic polymorphism showed significant differences in relation to genotypic frequency (χ^2 = 29.9860, df = 18, p = 0.0375) and allelic frequency (χ^2 = 19.2214, df = 9, p = 0.0234) each. In volleyball players and gymnasts, the Arg allele showed the highest frequency among sporting disciplines studied.

Table 4. Association between Trp64Arg polymorphism in the β_3-AR gene and cardiovascular parameters and functions in controls

Variables	Trp/Trp (n = 25)	Trp/Arg (n = 8)	t
Age [year]	22.1 ± 1.9	22.6 ± 2.3	0.683
Height [cm]	180.5 ± 4.7	182.6 ± 5.2	1.042
Weight [kg]	73.1 ± 7.9	75.1 ± 13.0	0.533
BMI [kg/m^2]	22.4 ± 2.0	22.4 ± 3.0	0.011
AR [cm]	2.9 ± 0.2	2.9 ± 0.2	0.242
LVIDD [cm]	5.2 ± 0.3	5.1 ± 0.4	–1.067
LVIDS [cm]	3.3 ± 0.3	3.1 ± 0.3	–1.320
LVM [g]	209.5 ± 40.0	224.3 ± 123.0	0.334
LVMI	108.5 ± 18.1	112.0 ± 48.5	0.309
SV [mL]	87.8 ± 12.6	84.5 ± 15.5	–0.602
HR_{rest} [beat/min]	66.0 ± 11.2	69.1 ± 14.8	0.628
CO [mL/min]	5789.9 ± 1263.4	5798.0 ± 1430.9	0.015
FS [%]	37.2 ± 3.3	38.5 ± 3.7	0.974
TC [mg/dL]	161.2 ± 65.1	155.0 ± 20.7	–0.263
TG [mg/dL]	147.1 ± 200.5	70.0 ± 32.8	–1.071
LDL-C [mg/dL]	86.0 ± 42.5	94.6 ± 16.2	0.554
HDL-C [mg/dL]	45.8 ± 8.4	46.4 ± 9.4	0.175
Glucose [mg/dL]	86.0 ± 10.8	84.0 ± 12.8	–0.438

The results are presented as a mean ± standard deviation; BMI — body mass index; AR — aortic root; LVIDD — left ventricular internal dimensions in end-diastole; LVIDS — left ventricular internal dimension in end-systole; LVM — left ventricular mass; LVMI — left ventricular mass index; SV — stroke volume; HR_{rest} — resting heart rate; CO — cardiac output; FS — fractional shortening; TC — total cholesterol; TG — triglicerydes; LDL-C — low density lipoprotein cholesterol; HDL-C — high density lipoprotein cholesterol

Clinical effects of Trp64Arg polymorphism in the β_3-AR gene

Subjects having Arg/Arg or Trp/Arg genotype were compared with ones having Trp/Trp genotype. The control group (Table 4) did not show any significant association in relation to any echocardiographic data and serum biochemical parameters. On the other hand, in the athletic group significant differences in the serum HDL-C level and the plasma glucose level occurred; particularly in athletes having Trp/Trp genotype, the serum HDL-C level was significantly lower (t = 2.313, p = 0.023) as compared to the athletes having other genotypes, but the plasma glucose level was significantly higher (t = –2.439, p = 0.017) (Table 5).

DISCUSSION

The Trp64Arg polymorphism of β_3-AR genes has been mostly analysed by use of polymerase chain reaction (PCR) and restriction fragment length polymorphism (RFLP) [12] however, in our study, the SNaPshot method was used to analyse this genetic polymorphism. The use of the SNaPshot method has been gradually increasing, for it is more convenient to determine genotypes as compared with the PCR-RFLP method [13].

The frequency of genotypes was in our study within the significant range of Hardy-Weinberg equilibrium, and was not much different from previous studies intended for Koreans [9]. Thus, they are representative for Koreans and there was no selection bias in our report.

Our study showed that there was no significant difference in genotypic and allelic frequencies between athletes and controls. However, statistically significant differences were observed in genotypic and allelic frequencies related to this genetic polymorphism in different types of sport activities. Especially in volleyball players (31.3%) and gymnasts (31.3%), the Arg allele showed the highest frequency.

There have been only few reports where genotypic and allelic frequencies were analysed in relation to the Trp64Arg polymorphism of β_3-AR gene in athletes of different sports. Lim et al. [9], examined the genotypic and allelic frequencies of this genetic polymorphism in Korean rugby players, basketball players, soccer players, handball players, filed hockey players, volleyball players, badminton players, gymnasts and taekwondo players, and reported that the Arg allele was the most frequent in volleyball players (38%) and basketball players (35%). Likewise, Santiago et al. [10], examined the genotypic and allelic frequencies of this genetic polymorphism in Spanish athletes of sports that need endurance or muscular power, and reported that the Arg allele was the most frequent in athletes that need endurance such as long-distance runners and cyclists. Ethic differences may play a role, howe-

Table 5. Association between Trp64Arg polymorphism in the β_3-AR gene and cardiovascular parameters and functions in athletes

Variables	Trp/Trp (n = 65)	Trp/Arg + Arg/Arg (n = 16)	t
Age [year]	21.3 ± 1.3	21.3 ± 1.1	–0.215
Height [cm]	178.8 ± 7.9	180.8 ± 10.5	0.716
Weight [kg]	73.6 ± 10.9	72.6 ± 9.1	–0.399
BMI [kg/m^2]	23.0 ± 2.9	22.2 ± 1.5	–1.139
AR [cm]	3.0 ± 0.3	3.0 ± 0.3	–0.254
LVIDD [cm]	5.5 ± 0.4	5.4 ± 0.3	–0.908
LVIDS [cm]	3.5 ± 0.4	3.4 ± 0.3	–1.502
LVM [g]	231.2 ± 44.6	217.0 ± 36.1	–1.177
LVMI	120.5 ± 18.4	112.8 ± 14.2	–1.563
SV [mL]	108.7 ± 24.1	111.7 ± 26.6	0.432
HR_{rest} [beat/min]	58.8 ± 10.0	59.2 ± 8.1	0.138
CO [mL/min]	6418.8 ± 1901.1	6660.9 ± 1965.7	0.453
FS [%]	36.2 ± 3.2	37.8 ± 3.7	1.778
TC [mg/dL]	157.4 ± 24.9	153.6 ± 22.9	–0.590
TG [mg/dL]	94.2 ± 48.7	80.6 ± 30.3	–1.065
LDL-C [mg/dL]	87.8 ± 19.6	80.0 ± 17.2	–1.568
HDL-C [mg/dL]	50.8 ± 9.8	57.4 ± 12.2	2.313*
Glucose [mg/dL]	89.4 ± 11.0	81.9 ± 10.8	–2.439*

*$p < 0.05$; the results are presented as a mean ± standard deviation; abbreviation as in Table 4

ver the results of this study were consistent with those of Lim et al. [9], in that the Arg allele indicated the highest frequency in volleyball players.

It has been suggested that genetic variation, which occurs in the gene that encodes this receptor, has the possibility to exert significant effects on cardiac structure and function. The β_3-AR, expressed in brown adipose tissue or white adipose tissue, controls energy metabolism and this receptor, expressed in the heart, may control cardiac contraction. However, only a few studies addressed this issue and were mostly focused on the structural and functional changes of the heart caused by hypertensive complications [14, 15]. For example, Liljedahl et al. [14], analysed 74 genetic polymorphisms in 25 candidate genes in order to asses whether genetic factors were involved in LVM changed by the injection of antihypertensive drugs. They reported that the Trp64Arg polymorphism of β_3-AR gene did not exert significant effects. In addition, Yuan et al. [15], analysed how the polymorphisms of genes, which encode three kinds of β-ARs including the β_3-AR, would affect the cardiac structure and function in hypertensive patients. They reported that Glu27Aln polymorphism in the β_2-AR gene was significantly associated with LV hypertrophy and LVMI, but found no significant association between the Trp64Arg polymorphism of β_3-AR gene and changes in cardiac structure or function.

Also in this study, it was found that in both athletic group and control group, the genotypes, which form the Trp64Arg polymorphism of β_3-AR gene, did not exert significant effects on any echocardiographic data related to cardiac structure and function. Altogether, it seems that the Trp64Arg polymorphism of β_3-AR gene is not a useful genetic marker that exerts significant effects on cardiac structure and function, irrespective of pathological or physiological changes.

In our study, the Trp64Arg polymorphism of β_3-AR gene was significantly associated with serum HDL-C level and plasma glucose level of athletes. To date, several results have been reported on this topic. Stangl et al. [16] analysed this genetic polymorphism in patients with coronary artery diseases and a control group composed of Germans. They reported that serum TC level was lower in the Arg/Arg genotype than in the Trp/Arg genotype. Okumura et al. [17] and Tsuzaki et al. [18] reported that this genetic polymorphism was significantly associated with serum LDL particle size of Japanese. In their studies, serum LDL particles got smaller in the order of Trp/Trp, Trp/Arg and Arg/Arg, and they suggested insulin resistance as the cause. Indeed, it is known that small LDL particles in blood and insulin resistance raise the risk of CV diseases. In some studies, the Arg allele was compared with the Trp allele, which forms the Trp64Arg polymorphism of β_3-AR gene. Although these studies did not show consistent results [19], in many reports the effects of the Arg allele was more significant in non-insulin-dependent diabetes mellitus and insulin resistance [20–30].

Unlike international studies that have reported that the Arg allele is significantly associated with metabolic abnormality, such as obesity or insulin resistance, in our study serum HDL-C level and plasma glucose level were lower in athletes having the Arg allele. The precise reason for this relationship is unclear, but besides the possibility of chance effect caused by modest sample size, presumably athletes' serum lipid profiles or insulin sensitivity are favourable thanks to regular and intensive exercise and thus they may overcome the mild influence of the Arg allele. Other possibility might be that these associations occur by linkage disequilibrium with close allele influencing some metabolic parameters. However, the precise mechanism for this remains unclear, and consequently further studies should be performed to clarify the precise mechanism behind our data.

This study has some limitations. Firstly, this is a cross-sectional study, and thus, a longitudinal study may be needed to clarify precisely the relationship between the Trp64Arg polymorphism in the β_3-AR gene and CV function in our study group. Secondly, this study has a low statistical power in detecting the statistical significance because of the modest sample size. Therefore, further studies using larger sample size are required.

References

1. Williams AG, Folland JP. Similarity of polygenic profiles limits the potential for elite human physical performance. J Physiol, 2008; 586: 113–116.
2. Bray MS, Hagberg JM, Pérusse L et al. The human gene map for performance and health-related fitness phenotypes: the 2006–2007 update. Med Sci Sports Exerc, 2009; 41: 34–72.
3. Moore GE, Shuldiner AR, Zmuda JM et al. Obesity gene variant and elite endurance performance. Metabolism, 2001; 50: 1391–1392.
4. Naga Prasad SV, Nienaber J, Rockman HA. Beta-adrenergic axis and heart disease. Trends Genet, 2001; 17: S44–S49.
5. Lipworth BJ. Clinical pharmacology of β_3-adrenoceptors. Br J Clin Pharmacol, 1996; 42: 291–300.
6. Gauthier C, Tavernier G, Charpentier F et al. Functional beta3-adrenoceptor in the human heart. J Clin Invest, 1996; 41: 35–73.
7. Gauthier C, Leblais V, Kobzik L et al. The negative inotropic effect of β_3-adrenoceptor stimulation is mediated by activation of a nitric oxide synthase pathway in human ventricle. J Clin Invest, 1998; 102: 1377–1384.
8. Skeberdis VA, Gendvilienė V, Zablockaitė D et al. Beta3-adrenergic receptor activation increases human atrial tissue contractility and stimulates the L-type Ca^{2+} current. J Clin Invest, 2008; 118: 3219–3227.
9. Lim BV, Choi KD, Chun GJ et al. Comparison of relative frequencies of angiotensin-converting enzyme and β_3-adrenergic receptor gene polymorphism of athletes in different events. Kor J Exerc Nutr, 2006; 10: 216–224.
10. Santiago C, Ruiz JR, Buxens A et al. Trp64Arg polymorphism in ADRB3 gene is associated with elite endurance performance. Br J Sports Med, 2010; Jun 11 [Epub ahead of print].
11. Friedewald WT, Levy RI, Fredrickson D. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem, 1972; 18: 499–502.
12. Widén E, Lehto M, Kanninen T et al. Association of a polymorphism in the β_3-adrenergic-receptor gene with features of the insulin resistance syndrome in Finns. N Engl J Med, 1995; 333: 348–351.
13. Norton N, Williams NM, Williams HJ et al. Universal, robust, highly quantitative SNP allele frequency measurement in DNA pools. Hum Genet, 2002; 110: 471–478.
14. Liljedahl U, Kahan T, Malmqvist K et al. Single nucleotide polymorphisms predict the change in left ventricular mass in response to antihypertensive treatment. J Hypertens, 2004; 22: 2321–2328.
15. Yuan M, Ohishi M, Ito N et al. Genetic influences of β_3-adrenoceptor polymorphisms on atrial functional changes and cardiac remodeling in hypertensive patients. Hypertens Res, 2006; 29: 875–81.
16. Stangl K, Cascorbi I, Laule M et al. The β_3-adrenergic receptor Trp64Arg mutation is not associated with coronary artery disease. Metabolism, 2001; 50: 184–188.
17. Okumura K, Matsui H, Ogawa Y et al. The polymorphism of the β_3-adrenergic receptor gene is associated with reduced low-density lipoprotein particle size. Metabolism, 2003; 52: 356–361.
18. Tsuzaki K, Kotani K, Fujiwara S et al. The Trp64Arg polymorphism of the β_3-adrenergic receptor gene is associated with increased small dense low-density lipoprotein in a rural Japanese population: the Mima study. Metabolism, 2007; 56: 1689–1693.
19. Büettner R, Schäffler A, Arndt H et al. The Trp64Arg polymorphism of the β_3-adrenergic receptor gene is not associated with obesity or type 2 diabetes mellitus in a large population-based Caucasian cohort. J Clin Endocrinol Metab, 1998; 83: 2892–2897.
20. Strosberg AD. Association of β_3-adrenoceptor polymorphism with obesity and diabetes: current status. Trends Pharmacol Sci, 1997; 18: 449–454.
21. Azuma N, Yoshimasa Y, Nishimura H et al. The significance of the Trp64Arg mutation of the β_3-adrenergic receptor gene in impaired glucose tolerance, non-insulin-dependent diabetes mellitus, and insulin resistance in Japanese subjects. Metabolism, 1998; 47: 456–460.
22. Fujisaw T, Ikegami H, Kawaguchi Y et al. Meta-analysis of the association of Trp64Arg polymorphism of β_3-adrenergic receptor gene with body mass index. J Clin Endocrinol Metab, 1998; 83: 2441–2444.
23. Pulkkinen A, Kareinen A, Saarinen L et al. The codon 64 polymorphism of the β_3-adrenergic receptor gene is associated with coronary heart disease or insulin resistance in nondiabetic subjects and non-insulin dependent diabetic patients. Metabolism, 1999; 48: 853–856.
24. Kawamura T, Egusa G, Okubo M et al. Association of β_3-adrenergic receptor gene polymorphism with insulin resistance in Japanese-American men. Metabolism, 1999; 48: 1367–1370.
25. Arner P, Hoffstedt J. Adrenoceptor genes in human obesity. J Intern Med, 1999; 245: 667–672.
26. Thomas GN, Tomlinson B, Chan JCN et al. The Trp64Arg polymorphism of the β_3-adrenergic receptor gene and obesity in Chinese subjects with components of the metabolic syndrome. Int J Obesity, 2000; 24: 545–551.
27. Oizumi T, Daimon M, Saitoh T et al. Genotype Arg/Arg, but not Trp/Arg, of the Trp64Arg polymorphism of the β_3-adrenergic receptor is associated with type 2 diabetes and obesity in a large Japanese sample. Diabetes Care, 2001; 24: 1579–1583.
28. Kurokawa N, Nakai K, Kameo S et al. Association of BMI with the β_3-adrenergic receptor gene polymorphism in Japanese: Meta-analysis. Obesity Res, 2001; 9: 741–745.
29. Park HS, Kim Y, Lee C. Single nucleotide variants in the β_2-adrenergic and β_3-adrenergic receptor genes explained 18.3% of adolescent obesity variation. J Hum Genet, 2005; 50: 365–369.
30. Zhan S, Ho SC. Meta-analysis of the association of the Trp64Arg polymorphism in the β_3-adrenergic receptor with insulin resistance. Obesity Res, 2005; 13: 1709–1719.

Rozkład występowania polimorfizmu $Trp^{64}Arg$ genu receptora β_3-adrenergicznego u sportowców a jego wpływ na czynność układu sercowo-naczyniowego

Sung Min Kim[1], Sang Duk Oh[1], In Geun Jung[1], Jin Lee[2], Young Je Sim[3], Jae Koo Lee[4], Byung Yong Kang[1]

[1]College of Physical Education, Hanyang University, Seul, Korea
[2]Department of Anatomy and Cell Biology, The College of Medicine, Hanyang University, Seul, Korea
[3]Department of Immunobiology, College of Human Sciences, Iowa State University, Ames, Iowa, USA
[4]Department of Leisure and Sports, Sahmyook University, Seul, Korea

Streszczenie

Wstęp: Związek polimorfizmu $Trp^{64}Arg$ genu receptora β_3-adrenergicznego z chorobami układu sercowo-naczyniowego został dokładnie zbadany, ale nie ma zbyt wielu danych na temat jego wpływu na czynność tego układu u sportowców.

Cel: Celem niniejszej pracy było wyjaśnienie zależności między polimorfizmem $Trp^{64}Arg$ genu receptora β_3-adrenergicznego a różnymi parametrami budowy i czynności serca oraz parametrami biochemicznymi krwi u koreańskich sportowców płci męskiej w porównaniu z grupą kontrolną.

Metody: Do badania włączono ogółem 114 mężczyzn, w tym 81 sportowców (8 biegaczy długodystansowych, 17 piłkarzy nożnych, 8 baseballistów, 10 koszykarzy, 8 siatkarzy, 8 hokeistów, 8 judoków, 6 zawodników uprawiających taekwondo i 8 gimnastyków) oraz 33 osoby z grupy kontrolnej. W celu oceny budowy i czynności serca wykonano 2-wymiarowe badanie echokardiograficzne, a parametry biochemiczne krwi oceniono za pomocą autoanalizatora. Genotyp polimorfizmu $Trp^{64}Arg$ genu receptora β_3-adrenergicznego określono metodą *SNaPshot*.

Wyniki: Genotyp i rozkład alleli polimorfizmu $Trp^{64}Arg$ genu receptora β_3-adrenergicznego różniły się istotnie między zawodnikami z różnych dyscyplin, a największą częstość występowania allelu Arg stwierdzono u siatkarzy i gimnastyków ($p < 0,05$). Stwierdzono również, że tylko u sportowców polimorfizm ten wykazywał istotny związek ze stężeniem cholesterolu frakcji HDL w surowicy i stężeniem glukozy we krwi ($p < 0,05$).

Wnioski: Mimo że uzyskane przez autorów dane świadczą o istotnym związku między polimorfizmem $Trp^{64}Arg$ genu receptora β_3-adrenergicznego a niektórymi parametrami wpływającymi na układ sercowo-naczyniowy u sportowców, takimi jak stężenie cholesterolu frakcji HDL w surowicy i stężenie glukozy we krwi, należy przeprowadzić kolejne badania w celu dokładnego wyjaśnienia mechanizmów będących podłożem tych zależności.

Słowa kluczowe: sportowcy, receptor β_3-adrenergiczny, polimorfizm

Kardiol Pol 2010; 68, 8: 920–926

Adres do korespondencji:
Byung Yong Kang, PhD, College of Physical Education, Hanyang University, 17 Haengdang-Dong, Seongdong-Gu, Seoul 133–791, Korea, tel: 82-2-3399-1692, faks: 82-2-3399-1464, e-mail: Kang1969@empal.com
Praca wpłynęła: 19.01.2010 r. **Zaakceptowana do druku:** 13.05.2010 r.