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Clinical Research

The Investigation of the Relationship Between Body Mass Index and Coronary Artery Calcium Index

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ABSTRACT

Objective: This study aims to investigate the relationship between body mass index and coronary artery calcium score.
Material and Methods: The patient files and records belonging to ones who underwent multi-detector computed tomography (MDCT) coronary angiography between 1 March 2014 and 1 February 2016 in our clinic were examined retrospectively. Those who had diabetes, hypertension, malignity, chronic disease and history of smoking were not included in the study. The patients were divided into five groups according to their body mass index (BMI). The coronary artery calcium (CAC) score of each patient was calculated according to Agatston's method. For the statistical analysis of the data, Oneway Anova was used for the differences between the groups, and regression analysis was used for the relationship between BMI and CAC scores.
Results: All of the patients were divided into five according to their BMI. The average calcium score was found as 0.62±0.15 for group 1, 21±3 for group 2, 126±25 for group 3, 340±17 for group 4, and 887±32 for group 5. There was a significant positive correlation between BMI and CAC scores value for the group 3, group 4 and group 5 (Group 3 r=0.34, Group 4 r=0.62, Group 5 r=0.53, p<0.05).
Conclusion: It was determined that there is a relationship between BMI and CAC scores indicating that as long as BMI increases, CAC scores increases prominently as well.

Keywords: *Body Mass Index, Coronary Artery Calcium Score, Computed Tomography.*

ÖZET

Vücut Kitle İndeksi İle Koroner Arterlerin Kalsiyum İndeksi Arasındaki İlişkinin Araştırılması

Amaç: Bu çalışmada vücut kitle indeksi (VKİ) ile koroner arter kalsiyum skoru (KAKs) arasındaki ilişkiyi araştırmayı amaçladık.
Gereç ve Yöntem: Anabilim Dalımızda 1 Mart 2014 ile 1 Şubat 2016 tarihleri arasında çok kesitli bilgisayarlı tomografi (ÇKBT) ile koroner anjiyografi yapılmış olgulara ait hastane dosyaları ve kayıtları retrospektif olarak incelendi. Diyabet, hipertansiyon malignite, kronik hastalığı olanlar ve sigara içenler çalışmaya dahil edilmedi. Olgular VKİ'sine göre beş gruba ayrıldı. Agatston'un kalsiyum skorlaması kullanılarak her bir olgunun koroner arter kalsiyum skorları tek tek hesaplandı. Verilerin istatistiksel analizi için, gruplar arası farklılıklar tek yönlü varyans analizi, VKİ ile KAKs arasındaki ilişki için regresyon analizi kullanıldı.
Bulgular: Tüm hastalar, VKİ'lerine göre 5 gruba ayrıldı. Grup 1'in kalsiyum skoru ortalaması; 0.62±0.15, grup 2'nin 21±3, grup 3'ün 126±25, grup 4'ün 340±17 ve grup 5'in de 887±32 olarak bulundu. VKİ ile KAKs arasında, grup 3,4 ve 5' te anlamlı pozitif korelasyon vardı (Grup 3 r=0.34, Grup 4 r=0.62, Grup 5 r=0.53, p<0.05).
Sonuç: VKİ ile KAKs arasında; VKİ arttıkça KAKs'nun da belirgin bir şekilde arttığını gösteren ilişki tespit edildi.

Anahtar Sözcükler: *Vücut Kitle İndeksi, Koroner Arter Kalsiyum Skoru, Bilgisayarlı Tomografi.*

Obesity is a clinic entity, which is the excessive fattening of body, and unless it is treated it can result in such clinical cases as metabolic changes, hypertension, dyslipidemia and diabetes. Its prevalence is increasing all over the world, and it is becoming a major health problem in many countries. Obesity, which is related with increasing of morbidity and mortality, is regarded as an illness (1, 2).

There is a close link between vessel wall calcification in coronary artery and atherosclerotic coronary artery disease. A lot of studies are conducted to determine

The exact determination of body fat index takes long time and it is troublesome. In determining obesity, BMI is used, which is the ratio of human body weight to squared height.

WHO (World Health Organization), regards a BMI risk factors for atherosclerotic heart diseases. Body mass index (BMI) is an index which is used in many fields of medicine to determine obesity limit and its unit is kg/m^2 (3-5).

Determining coronary artery calcium level to specify the level and distribution of coronary artery calcification is an important parameter for diagnosing cardiovascular risk in advance. Multi-detector computed tomography (MDCT) is the candidate for the routine use as a sensitive method for detection of coronary calcium deposition (6-8).

under 18.5 kg/m^2 as underweight, 18.5 - 24.9 kg/m^2 as normal, 25 - 29.9 kg/m^2 as overweight, 30 - 39.9 kg/m^2 as obesity, and over 40 kg/m^2 as very morbid obesity (7-10). Between obesity and atherosclerotic coronary artery disease (CAD) is a close link, and American

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Heart Association (AHA) defines this as a major risk factor for coronary heart disease (8-11).

Determining coronary artery calcification level by using coronary artery calcium (CAC) scores is an important parameter in for diagnosing cardiovascular risk in advance. MDCT is used as a sensitive non-invasive method for diagnosing coronary calcium deposition and CAD (7, 12-14).

In this study, we determined coronary artery calcium level and investigated the relationship between BMI and CAC scores using MDCT.

MATERIAL AND METHODS

Patient Enrolment

After clinical research ethics board approval received, patient files and records belonging to asymptomatic ones who underwent MDCT coronary angiography with Toshiba Aquilion; Toshiba Medical Systems, Tokyo, Japan between 1 March 2014 and 1 February 2016 were examined in our clinic. The patients diabetes, hypertension, malignity, with a chronic disease and history of smoking were not included in the study.

Patients Group

All of the patients were divided into five groups according to their BMI. The ones with a BMI under 18,5 kg/m^2 consisted the group 1 (underweight, n=40), those between 18,5 kg/m^2 and 24.9 kg/m^2 are the group 2 (normal, n=40), the ones between 25 kg/m^2 and 29.9 kg/m^2 made up the group 3 (over-weighted, n=40), the ones between 30 kg/m^2 and 39.9 kg/m^2 are the group 4 (obese n=40), and finally those over 40 kg/m^2 were named as the group 5 (very severely weighted, n=40). The data about the groups are presented in Table 1.

Table 1. *Exploratory Data of the Groups According to BMI*

		Gender		Calcium Score				
		Male	Female	Very Low	Low	Normal	Moderately High	High
Group 1 (n=40)	Number (%)	23 (57.5)	17 (42.5)	25 (62.5)	15 (37.5)			
	Age (Average.±SS)	46.8±9	44.7±10					
Group 2 (n=40)	Number (%)	23 (57.5)	17 (42.5)		16 (40)	24 (60)		
	Age (Average.±SS)	46.8±10	45.8±10					
Group 3 (n=40)	Number (%)	24 (60)	16 (40)			32 (80)	5 (12.5)	3 (7.5)
	Age (Average.±SS)	43.6±10	42.2±9					
Group 4 (n=40)	Number (%)	24 (60)	16 (40)				33 (82.5)	7 (7.5)
	Age (Average.±SS)	45.2±9	43.8±8					
Group 5 (n=40)	Number (%)	23 (57.5)	17 (42.5)					40 (100)
	Age (Average.±SS)	45.6±11	47.5±7					

Evaluation of Images

CAC scores of each patient was assessed retrospectively at workstation (VITAL, Vitrea 2, HP XW6400 Workstation, America). Using Agatston's calcium scoring method, CAC scores of the patients was calculated one by one. According to Agatston's calcium scoring system, the patients were divided into five groups.

Statistical Analysis

For the statistical analysis of the data, Oneway Anova was used for the differences between the groups, and fit gaussian analysis was used for the relationship between BMI and CAC scores, and $p<0.05$ was accepted as significant.

RESULTS

One hundred and seventeen (%58.5) of the total 200 patients were male, while the rest 83 (%41.5) are female. Their average age is 45±10 and the age range is between 20 and 71. The average CAC scores of the groups was found to be 0.62±0.15 for group 1, 21±3 for group 2, 126±25 for the group 3, 340±17 for the group 4, and 887±32 for the group 5 (Figure 1).

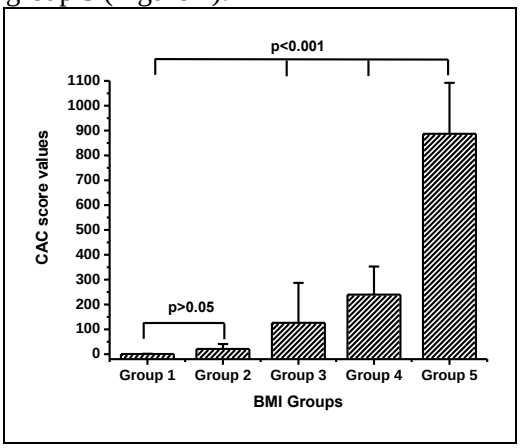

Figure 1*. CAC scores between the groups which are formed according to BMI*

The minimum calcium score was calculated as 0, while the maximum score was 1387. In the

groups, which were created according to BMI, the distributions according to age, gender and calcium scores were presented in Table 1.

When the scores of CAC and BMI among the groups are compared statistically, no significant relationship between the groups 1 and 2 was found ($p>0.05$). Between the all other groups, there is statistically significant relationship ($p<0.001$). Moreover, it was found out that gender does not have an effect on CAC scores on its own, and gender and BMI together do not have a statically significant effect on CAC scores ($p>0.05$).

When we examine the correlation between BMI and CAC scores in each group, there is a significant positive correlation in groups 3, 4 and 5. The scores were calculated as ($R=0.34$ $p<0.05$), ($R=0.62$ $p<0.01$), ($R=0.53$ $p<0.01$) for the groups 3, 4 and 5 respectively. Moreover, without making a distinction between the groups, when the correlation between BMI and CAC scores of everyone in the groups was examined, it is seen that in figure 2.

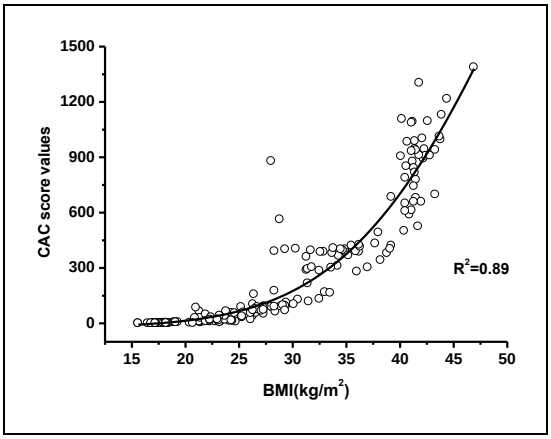

Figure 2. *The relationship between BMI and CAC scores of all the groups.*

For each group, there is no a statistically significant correlation between age and CAC scores.

DISCUSSION

While displaying coronary artery calcification symptoms make us to doubt if there is CAD, a high score of coronary artery calcium increases the likelihood of major coronary disease distinctly. In literature, it is shown that the risk of major coronary disease in patients with a low CAC score is two times higher than those without coronary artery calcification, and this risk, depending on the score, can be up to from 4 to 17 times in patients with high scores (14-17).

Atherosclerosis, starting at an early age, is a multi-factor, systemic and progressive disease which affects arteries. Around the world, CAD is known to be the most important cause of mortality and morbidity. Considering systemic involvement of atherosclerosis, the same relation is expected to have a close link with coronary artery atherosclerosis (18, 19).

Obesity is an established risk factor for cardiovascular disease, and it is increasing at an alarming rate worldwide. In a study, bodyweight is defined as a risk factor which has a moderate effect on CAD. In the studies carried out in western countries with coronary artery patients, half of the women and majority of men have been reported to be over excessive weight limit (20).

In another two studies, obesity is found to be an independent risk factor for CAD, and it is also stated that as long as BMI increases, there is a linear increase in risk of cardiovascular disease (21, 22). In some studies, contrary to females; in males, there was found a stronger relationship between BMI and CAD in middle ages than in older ages (23, 24). In another study, while in men over 70, a high level BMI was found as a coronary artery risk, there is not a significant risk in females (25). In a study in our country, it was found out that female coronary artery patients have higher BMI averages than males have (26).

Kronmal et al. (27) determined in their studies in which they carried out on 5756 multi-ethnic, asymptomatic patients to examine risk factors affecting progression at coronary artery calcification that the incidence of coronary artery calcification increases with aging. They also determined in this study, which they studied approximately 2.4 years on a group with no one known cardiovascular disease, that age, gender and BMI, which are all cardiovascular risk factors, are effective in the formation of coronary artery calcification.

Since the possibility of future cardiac events has a close link with atherosclerotic disease, determining the amount and distribution of coronary artery calcium is important for determining the risk of cardiovascular disease in advance. Coronary artery calcium scanning performed with computed tomography is considered the gold standard for the detection of coronary artery calcium and is a commonly used imaging method recently (7).

In our study, according to statistics results, while there is no significant difference between the groups 1 and 2 for BMI and CAC scores, between the all other groups, there is statistically significant difference. The ones with a high BMI score were observed to have a high CAC score. As a result, there is significant relationship between BMI and CAC scores.

In conclusion; it cannot be strong relationship between body mass index and CAC scores, when presence of diabetes, hypertension, malignancy, chronic disease, and the smokers is not homoge-

neous between the groups. In the literature these studies are a few, and it is thought to be the studies show more clearly the effect of BMI and CAC scores with homogenous groups. In our study, diabetes, hypertension, malignancy, chronic disease, and smokers involved in the study and thus, have revealed a strong relationship between the BMI with CAC scores.

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