

Prevalance of Non-Coronary Findings in Patients Undergoing Cardiac Multidetector Computed Tomography Scans

Kardiyak Çok Kesitli Bilgisayarlı Tomografi İle Değerlendirilen Hastalarda Koroner Dışı Bulguların Prevalansı

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Abstract

Aim To investigate non-coronary findings during coronary calcium scoring with computed tomography.

Material and Method 190 patients who were evaluated with multislice computed tomography for coronary calcium scoring, were included in the study. Non-coronary findings were described as Minor and Major A-B findings.

Results One hundred seventy seven non-coronary findings were found at 80 (42.1%) patients. There were minor findings at 40 (21%) and major findings at 40 (21%) of the patients. There were 13 Major B findings including aortic aneurysm, pulmonary mass, pulmonary nodules, infiltrates, pneumonectomy, surrenal nodular thickening and liver mass lesions.

Conclusion Non-coronary findings are frequent, and radiologist and/or cardiologist who has been reporting these findings should be aware of the frequency and importance of these findings. (*Sakarya Med J* 2016, 6(4):224-230)

Keywords Coronary calcium score; Multislice computed tomography; Non-coronary findings

Öz

Amaç Çok kesitli bilgisayarlı tomografi ile yapılan koroner kalsiyum skorlaması sırasında kalp dışı bulguları incelemek.

Materyal ve Metod Çalışmaya 190 çok kesitli bilgisayarlı tomografi ile koroner kalsiyum skorlaması yapılan hasta alındı. Kalp dışı bulgular Minor, Major A-B olarak tanımlandı.

Bulgular Çalışmaya alınan hastalardan 80'inde 177 kalp dışı bulgu tespit edildi (42.1%). Bu hastaların 40'ında minor bulgular (21%), 40'ında major bulgular (21%) mevcuttu. Majör B bulgular aort anevrizması, akciğerde kitle, akciğer nodülleri ve infiltrasyonları, pnömonektomi, böbrek üstü bezde nodüler kalınlaşma ve karaciğer kitle lezyonlarını içermektedir.

Sonuç Kalp dışı bulgular sık görülür. Bu bulguları raporlayan radyolog ve/veya kardiyologlar, bu bulguların sıklığı ve önemi konusunda dikkatli olmalıdırlar. (*Sakarya Tıp Dergisi* 2016, 6(4):224-230).

Anahtar Kelimeler Koroner kalsiyum skoru, koroner dışı bulgular, çok kesitli bilgisayarlı tomografi

INTRODUCTION

In developed countries, cardiovascular disease (CVD) is the leading cause of death, and will be the most important cause of mortality and morbidity in developed countries by 2020¹. Coronary artery disease (CAD) is the most common clinical result that develops in presence of atherosclerosis during CVD. Because of this condition, the screening tests (multislice computed tomography (MSCT), etc.) for this disease are crucial².

Electron Beam Computed Tomography (EBCT) and MSCT are used for non-invasive cardiac imaging, and coronary artery calcium scoring (CACS). Coronary calcium scoring with MSCT is a commonly used, noninvasive imaging method that has been regarded as gold standard for the determination of calcification on coronary arteries³. The heart, the great vessels, and coronary arteries, as well as lungs, bones, and the upper abdomen can be screened and evaluated with MSCT.

The aim of this study was to determine the incidence of non-coronary findings (NCF) during CACS with MSCT, and to search for whether there is a relationship between CAD risk factors and non-coronary findings with CACS.

MATERIALS and METHODS

One hundred ninety patients who were evaluated with 16-detector MSCT (Toshiba multislice Aquilion 16 system, Toshiba Medical Systems, Otawara, Japan) for CACS, were included in the study. History of hypertension (HT), diabetes mellitus (DM), smoking, hyperlipidemia (HL), myocardial infarction (MI), percutaneous coronary intervention, coronary artery bypass operation, and heart failure were recorded for each individual. The images at CT work station (Vitrea, Toshiba) were observed by two radiologists and one cardiologist who were blinded to individuals. This retrospective study was approved by our local ethics committee.

According to Agatston scoring which is a method based on coronary calcium scoring, for 2-3 pixels adjacent to each other in an area wider than 1 mm², lesions whose CT densities has been higher than 130 Hounsfield unit (HU), are significant for calcification^{5,6}. All non-coronary findings were noted. Non-coronary findings were divided into major and minor. Major group was also divided into two subgroups, major A and ma-

ior B. Minor group described as insignificant clinical findings, major A group described as moderately severe findings that require follow-up, major B group described as findings that are remarkable, need to search etiology, and require further examination and/or treatment.

Calcified nodules in lung, fibrotic band, bullous emphysema, atelectasis, bronchiectasis, calcified mediastinal lymph nodes smaller than 1 cm, pleural calcifications, and calcifications of atherosclerotic plaque in the aorta intense, widespread degeneration of vertebrae, hemangioma, spondylosis, liver cyst, steatosis, calcification, hiatal hernia, bochdalek hernia and splenic calcification were included in minor findings. Larger than 5 mm noncalcificated nodules, areas of frosted glass density, cavitation, mediastinal lymph nodes larger than 1 cm, pleural thickening, valve calcifications, pericardial calcification, and effusion, the ascending aorta with diameter of 40-50 mm, increase in pulmonary artery diameter, pneumobilia, and ascites were included in major A group.

Amongst the nodules in lung whose diameters were larger than 10 mm, smooth-edged nodules were also included in this group. 13 mm nodule which has suspected irregularity of contour that was seen in lung, two unidentified hypodense lesion in the liver, nodular thickening at surrenal gland, infiltration at lung, pulmonary solid mass, pneumonectomy, and aortic aneurysm with diameter of >50 mm were included in major B group.

Statistical analysis

All statistical analysis were done by SPSS 15.0 (SPSS for Windows; SPSS Inc., Chicago, IL, USA). For discrete and continuous data, percentage and median (min-max) values were used in descriptive statistics, respectively. For comparison between groups with discrete variables and continuous variables, the chi-square and Mann-Whitney U tests were used, respectively. To determine independent risk factors, logistic regression analysis was done. A p value < 0.05 were accepted as significant.

RESULTS

Clinical and demographical findings of NCF (+) and NCF (-) groups are shown in Table 1. Of 190 patients 107 was male

(56.3%) and 83 was female (43.7%) included in our study. The mean age was 53.95 ± 14.05 years. Agatston score 0 was at 101 cases (53%), and Agatston score >400 was found at 16 cases (8.4%) (Figure 1). In our study, a total of 177 non-coronary findings were observed at 80 cases (42%). 52 of the NCF were found in lungs [Minor findings were calcific nodule <1 cm, 5 (2.6%); fibrotic band, 14 (7.3%); emphysema, bulla, 8 (4.2%); atelectasia, 5 (2.6%), bronchiectasia, 2 (1%); major A findings were calcific nodule <1 cm, 5 (2.6%); fibrotic band, 14 (7.3%); noncalcific nodule < 8 mm, 9 (4.7%); infiltration, 2 (1%); cavitation, 1 (0.5%); major B findings were nodule > 8mm, 1 (0.5%); infiltration, 2 (1%); solid mass, 1 (0.5%); pneumonectomy, 1 (0.5%)],

Table 1. Clinical and demographical characteristics of non-coronary findings (+) and (-) patients

	NCF (-) n (%)	NCF (+) n (%)	Total n (%)
Number of patients (n)	110	80	190
Average age	51.74	57.00	53.95
<40 years	24 (21.8)	14 (17.5)	38 (20.0)
40-59 years	54 (49.1)	26 (32.5)	80 (42.1)
≥60 years	32 (29.1)	40 (50.0)	72 (37.9)
Male	64 (58.2)	43 (53.8)	107 (56.3)
History of coronary angiography	18 (16.4)	7 (8.8)	25 (13.2)
History of coronary bypass surgery	0 (0%)	1 (1.2)	1 (0.5)
Hypertension	49 (44.5)	37 (46.2)	86 (45.3)
Diabete mellitus	20 (18.2)	26 (32.5)	46 (24.2)
Smoking	48 (43.6)	51 (63.8)	99 (52.1)
Hyperlipidemia	52 (47.3)	54 (67.5)	106 (55.8)
Chest pain	61 (55.5)	34 (42.5)	95 (50.0)
Dispnea	28 (25.5)	23 (28.8)	51 (26.8)
Prior myocardial infarction	9 (8.2)	0 (0)	9 (4.7)
Heart failure	3 (2.7)	2 (2.5)	5 (2.6)
Agatston score			
0	63 (57.3)	38 (47.5)	101 (53.2)
1-10	10 (9.1)	8 (10.0)	18 (9.5)
11-100	14 (12.7)	13 (16.2)	27 (14.2)
101-400	15 (13.6)	13 (16.2)	28 (14.7)
>400	8 (7.3)	8 (10.0)	16 (8.4)
NCF: non-coronary findings			

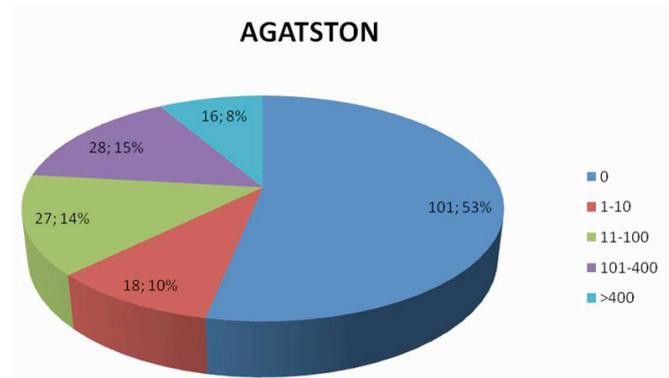


Figure 1. Distribution of the Agatston scores of the cases. Twenty three of them were found in mediastinum, 10 of them were found in pleura, 36 of them were found at the cardiovascular system, 25 of them were found in vertebral and 31 of them found in abdomen (Figure 2). In NCF (+) group, age, smoking, HL and DM were higher than NCF (-) group. A total of 127 minor findings, 37 major A findings, 13 major B non-coronary findings in NCF (+) patients.

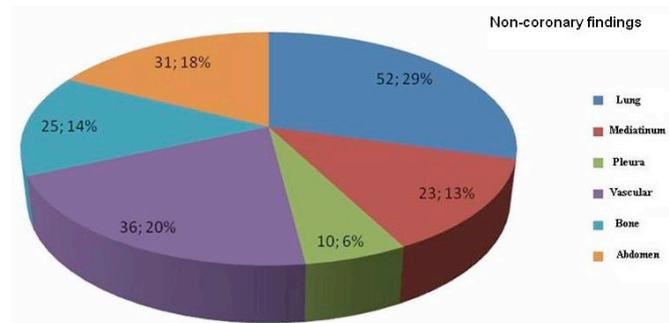


Figure 2. The distribution of the number of non-coronary findings by anatomic site. Patients who were > 60 years have significantly higher NCF than patients who were < 60 years (56%, 34%, respectively, $p < 0.05$). Major A NCF (22% - 10%) and major B NCF were significantly higher in patients who were > 60 years than patients who were in young and middle age groups ($p < 0.05$) (Table 2, Figure 3).

Comparison of two groups of which Agatston score was 0-400 and >400, is shown in Table 3. NCF was higher in Agatston score >400 patients than Agatston score <400 (n: 50, n: 42, respectively). In the group at which CACS was found higher than 400, the rate of Major B patients was found higher than the group at which Agatston score was 400 and below (13%,

Table 2. Relation between Agatston score, subgroup characteristic (gender and age) and non-coronary findings

	n (%)	NCF (+) n (%)	Major A group n (%)	Major B group n (%)	Number of NCF	Major A NCF n (%)	Major B NCF n (%)	NCF / NCF (+) patient ratio
Agatston score								
≤400	174 (92)	72 (42)	25 (14)	11 (6)	164	34 (21)	11 (7)	2.3
>400	16 (8)	8 (50)	2 (13)	2 (13)	13	3 (23)	2 (15)	1.6
<40 years	38 (20)	13 (34)	4 (11)	1 (3)	21	4 (19)	1 (5)	1.5
40-59 years	80 (42)	27 (34)	7 (9)	4 (5)	48	8 (17)	4 (8)	1.8
>60 years	72 (38)	40 (56)	16 (22)	8 (11)	108	25 (23)	8 (7)	2.7
Male	107 (56)	43 (40)	11 (10)	9 (8)	97	19 (21)	9 (9)	2.3
Female	83 (44)	37 (45)	16 (22)	4 (5)	80	18 (25)	4 (5)	2.2
Total	190	80 (42)	27 (15)	13 (7)	177	37 (21)	13 (7)	2.2

NCF: non-coronary findings

Table 3. Multivariate analysis of relationship between variables and non-coronary findings

Variable	Odds ratio (%95 CI)			
	NCF	Minor	Major A	Major B
Age ≥ 60	2.8 (1.4-5.8)	1.9 (0.8-4.6)	4.5 (1.5-12.6)	5.2 (1.3-21.2)
Female	1.2 (0.7-2.1)	0.9 (0.4-1.9)	2.3 (0.9-5.3)	0.6 (0.2-2.1)
Male	0.8 (0.5-1.5)	1.1 (0.5-2.3)	0.4 (0.2-1.0)	1.6 (0.5-5.6)
DM	2.5 (1.1-5.8)	3.2 (1.2-8.5)	3.4 (1.1-10.7)	0.5 (0.1-3.3)
Smoking	2.1 (1.1-4.1)	2.0 (0.8-4.8)	3.1 (1.1-8.9)	3.1 (0.7-14.9)
Agatston score ≥ 400	0.6 (0.2-2.0)	0.7 (0.2-2.9)	0.4 (0.1-2.3)	1.1 (0.2-6.9)
HL	2.0 (1.0-3.9)	1.9 (0.8-4.2)	1.8 (0.7-4.7)	3.3 (0.8-13.1)
Chest pain	0.4 (0.2-0.8)	0.4 (0.2-0.8)	0.3 (0.1-0.8)	1.4 (0.3-5.4)
HT	0.5 (0.3-1.1)	0.6 (0.2-1.4)	0.4 (0.1-1.3)	0.6 (0.2-2.6)

CI: Confidence Interval, NCF: non-coronary findings, DM: Diabetes mellitus, HL: Hyperlipidemia, HT: Hypertension

6%, respectively). Major B NCF were higher but not significant in Agatston score >400 than Agatston score <400 (15%, 7%, respectively, $p>0.05$) (Table 2).

Among the significant abnormalities, the three most common were pulmonary nodules (16.7%), emphysema (16.7%) and possible hepatic carcinomas (12.6%).

The multivariate analysis on the potential relationship between CAD risk factors and non-coronary findings is shown on Table 3. The significant positive relationship between age, smoking, DM, HL and all NCF was found.

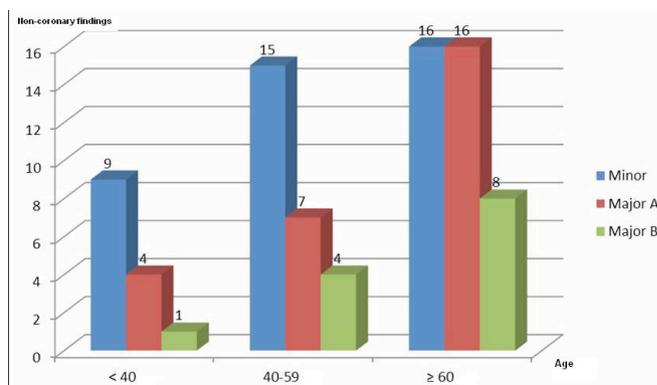


Figure 3.. Number of cases with non-coronary findings found in minor, major groups A and B according to age groups.

Table 4. Incidental non-coronary findings in cardiac imaging: Literature summary

Authors	Year	Study	Type of CT	Number of patient	Minor ECF	Major ECF
Hunold et al. ⁶	2001	CACS	EBCT	1812	53%	11%
Onuma et al. ⁷	2006	Coronary MSCT	16+64 MSCT	503	58.1%	22.7%
Greenberg-Wolff et al. ⁸	2008	Coronary MSCT	40 MSCT	134	76.8%	39%
Chia et al. ⁹	2009	Coronary MSCT	64 MSCT	1061	8.0%	3.1%
Koonce et al. ¹⁰	2009	Coronary MSCT	64 MSCT	737	26.6%	20.2%
Dewey et al. ¹¹	2007	Coronary MSCT	16 MSCT	108	10%	5%
Kawano et al. ¹²	2007	Coronary MSCT	64 MSCT	625	24.1%	5.8%
Horton et al. ¹⁴	2002	CACS	EBCT	1326	7.8%	5%
Haller et al. ¹⁵	2006	Coronary MSCT	16 MSCT	166	19.9%	4.8%
Türkvatan et al. ¹⁶	2009	Coronary MSCT	16 MSCT	375	22.1%	19.2%
Bendix et al. ¹⁹	2011	Coronary MSCT	128 MSCT	1383	22%	6.8%

ECF: non-coronary findings, MDCT: multidetector computerized tomography, EBCT: electron beam computerized tomography, CACS: coronary calcium score

DISCUSSION

The presence of calcification in coronary arteries is sign of the coronary atherosclerosis. Studies have shown that there is a linear relationship between the amount of calcium and the total atherosclerotic plaque burden. In advanced ages, the amount and distribution of coronary artery calcium provides valuable information to predict the risk of CVD⁴). EBCT and MSCT are non-invasive diagnostic methods that determine the presence and amount of coronary artery calcium in both asymptomatic and symptomatic patients. To search non-coronary findings during calcium scoring by MSCT is crucial because of the factors such as explaining clinical symptoms of the patient, detecting the presence of an underlying malignancy or providing early diagnosis and treatment.

At previous studies done with EBCT and MSCT, incidental NCF ratio was 8–77 %. (Table 4). Most of these findings (atelectasis, hepatic cyst, etc.) were unremarkable⁵⁻¹⁴. In previous studies clinically significant NCF (pneumonia, malignancy, aneurysms, etc.) rates were between 3- 39%^{9,10}. Moreover, the presence of heterogeneity in NCF ratios may depend on the differences between the definitions of NCF and MSCT up-protocol.

Greenberg-Wolff et al. found that one or more NCF in 76.8% of the patients, and remarkable NCF ratio is 39%, but in our study this ratio was found less⁸. Türkvatan et al. found that

22.1% of the 375 patients have unimportant non-coronary findings, and at 19.2% of them has important non-coronary findings¹⁵. These ratios are similar with our study. At MSCT for calcium scoring or coronary angiography, incidental pulmonary nodule incidence changed between 5% to 20%^{6,7,12,13,15-17}. In our study, there were found non-calcificated nodule in totally 11 patients. 10 of them were included in Major A, and one of them was included in major B group because of its suspicious image.

In our study, there was positive correlation between age and incidental findings, like previous studies^{6,9,18}. There are few studies which investigate the correlation between CACS and presence of NCF, risk factors, symptoms in literature¹⁹. Similarly in our study, the strongest correlation with presence of NCF was age.

Different from previous study, in our study there were significant correlations between HL, DM and presence of NCF¹⁹. Bendix et al. could not demonstrate significant correlation between Agatston scoring, gender and presence of NCF, we also could not found these relations in our study¹⁹. Budoff and his colleagues argued that an extra study for searching non-cardiac findings, analyzing the data of MSCT again may cause unnecessary anxiety in patients, extra costs and radiation dose and moreover, it may cause potential risks related to invasive diagnostic tests, in turn, these studies did not have any pro-

ven benefit²⁰. Similarly, Machaalany and colleagues postulated that to analyze the NCF has no clear benefit on mortality but it would lead to additional costs and morbidity seriously¹⁸. When the detected findings in our study such as aortic aneurysm, pulmonary mass, liver mass, pulmonary nodule were taken into account, we thought that CACS examination with MSCT should be evaluated by cardiac imaging specialist , and using different image field settings and not just concentrate on the heart but all extracardiac fields when detected.

CONCLUSION

In patients on whom CACS is applied by MSCT, incidental non-coronary findings were seen frequently, and sometimes clinically important findings such as malignancy, aneurysm can be found. Age, smoking, diabetes and HL have a relationship with the presence of non-coronary findings. The follow-up of major non-coronary findings or the research for diagnosis and treatment in case of clinical necessity are important for early diagnosis and treatment.

Conflict of interest: None declared.

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