The Incidence of Coronary Artery Calcification on Standard Thoracic Multislice Computed Tomography Scans

Standart Çok Kesitli Göğüs Bilgisayarlı Tomografi Taramalarında Koroner Arter Kalsifikasyonlarının İnsidansı

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ABSTRACT Objective: The purpose of this study was to determine the incidence of coronary artery calcification (CAC), based on gender and age differences in participants undergoing multislice computed tomography (MSCT) screening for lung disease. **Material and Methods:** We performed MSCT screening for lung diseases on 884 participants, all without documented prior cardiovascular disease. All of the patients underwent imaging with a 16-detector-row computed tomography (CT) at 120 kVp and 75 mAs, 5 mm slice thickness. Visualized CACs in each coronary artery (main, left anterior descending, circumflex, and right) were recorded. **Results:** During the study period, 884 patients (530 male and 354 female), in the age range of 20 to 88 years (mean 57±13 years) for male, 20 to 94 (mean 53±16) for women. The incidence of CAC increased significantly as age increased. The incidence of CAC was higher in males than females, up until age 69. CAC was present in 33.6% of men and 16.9% of women. In subjects younger than 40 years, a positive CAC prevalence was 2.2% for men and 0% for women; in those older than 40 years, the frequency increased for both men and women, but the increase in women was greater than that in men after age 69. **Conclusion:** Standard thorax MSCT could reveal the most likely stenosis areas by distinguishing those that are probably with calcification from the areas without calcification. There is an increase in the incidence of CAC with age. Male subjects are more likely than female subjects to have detectable CAC up until age 69 years. This study has shown that it is possible, using our everyday equipment, to find important diagnostic data indicating the probability of coronary artery disease.

Key Words: Vascular calcification, coronary artery disease, computed tomography, incidence

ÖZET Amaç: Çalışmanın amacı akciğer hastalığı için çok kesitli bilgisayarlı tomografi (ÇKBT) ile taranan kişilerde cinsiyet ve yaş bazında koroner arter kalsifikasyonunun (KAK) insidansını ortaya koymaktı. **Gereç ve Yöntemler:** Daha önce kardiyovasküler bir hastalığı belirlenmemiş 884 kişide, akciğer hastalığı taraması için ÇKBT kullanıldı. Hastaların hepsine 16 sıra dedektörlü bilgisayarlı tomografi (BT) ile 120 kvp, 75 mAs ve 5 mm kesit kalınlığı uygulandı. Her bir koroner arterdeki (ana, anterior inen, sirkumfleks ve sağ) KAK'lar kaydedildi. **Bulgular:** Çalışma periyodu sırasında 884 hasta (530 erkek ve 354 kadın), erkekler için yaş ranjı 20-88 (ortalama 57±13) kadınlar için 20-94 (ortalama 53±16) idi. KAK insidansı özellikle yaşla orantılı olarak artmaktaydı. KAK insidansı 69 yaşına kadar erkeklerde kadınlardan daha yüksek idi. KAK erkeklerin %33.6'sında kadınların %16.9'unda mevcut idi. Kırk yaşından daha genç kişilerde KAK pozitifliği erkekler için %2.2, kadınlar için %0 idi. Kırk yaşından daha yaşlı hem erkeklerde hem kadınlarda görülme sıklığı artmaktaydı. Ancak 69 yaşından sonra artış kadınlarda erkeklerden daha fazla idi. **Sonuç:** Standart göğüs ÇKBT muhtemel kalsifikasyonlu ve kalsifikasyonsuz alanları ayırt ederek çok muhtemel stenoz alanlarını ortaya koyabilir. Yaş arttıkça KAK'ın insidansında artma vardır. Altmış dokuz yaşına kadar erkeklerde kadınlardan daha fazla KAK belirlenebilir. Bu çalışma göstermiştir ki günlük ekipman kullanılarak, koroner arter hastalığı ihtimalini gösteren önemli bir diyagnostik veriyi bulmak mümkündür.

Anahtar Kelimeler: Vasküler kalsifikasyon, koroner arter hastalığı, bilgisayarlı tomografi, insidans

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Early diagnosis and changes in several risk factors are essential elements for reducing mortality or morbidity or both, in coronary artery disease. In these patients, early intervention and changes in risk factors have great value. In many patients with early lesions or who are still in an asymptomatic phase, stenosis may not be detected, showing that calcium detection in coronary arteries is an important predictor of coronary artery disease, mainly in young patients.[1,2]

The absence of CAC is not consistent with the absence of coronary artery disease; however, an incidental occurrence of CAC is an important finding that hints at the presence of the disease.[1-4]

Because calcific deposits are radiopaque, numerous radiographic techniques have been used in the search for a non-invasive screening test for coronary artery disease.[1,4-8] Cinefluoroscopy of the heart has been utilized to image calcific deposits associated with severe obstructive coronary disease.[7] More recently, interest in coronary calcification as a marker of atherosclerosis has been stimulated by advances in radiographic imaging [i.e. electron-beam computed tomography (EBCT) and multislice CT] that permit increased resolution of vascular calcification.

The aim of this study was to establish the age/sex frequency of CAC in patients undergoing standard, MSCT scans of the thorax for the diagnosis and assessment of respiratory and not cardiac disease.

MATERIAL AND METHODS

We conducted an MSCT scan on 884 patients (530 male and 354 female) with ages ranging from 20 to 88 years (mean 57±13 SD) for men, and 20 to 94 (mean 53±16 SD) for women, between February and August 2006. All the scans were performed on an adult population for the diagnosis and assessment of thoracic diseases. The scans were performed for a variety of clinical indications, but the most frequent were the diagnosis and assessment of bronchial carcinomas, the identification of metastatic disease, mediastinum assessment, and the diagnosis of a solitary nodule noted on a chest radiograph.

IMAGING AND READING OF THE IMAGES

The MSCT test was performed using a 16-detector-row CT (Toshiba-Aquillon TSX-101A-16) slice at 120 kVp and 75 mAs, with 0,5 sn/5mm/2X16 in a single breath hold. The scans were performed from the apex to the base of the thorax, using a standard thoracic protocol.

The MSCT images were reviewed together by two experienced chest radiologist. Both were aware that the images had been derived from the initial CT test in screening for the diagnosis and assessment of thoracic diseases. The readers viewed the images on a high-resolution monitor, at its typical window and level settings with maximal magnification, scrolling through the images one by one. For the purpose of assessing CAC, the settings were standardized using standard mediastinal window settings (width=750 HU; level=350 HU).

CORONARY ARTERY CALCIFICATION EVALUATION

CAC was only positively identified when observed in the anatomical site of the circumflex, left main, anterior descending or right coronary artery. There was an awareness of the potential pitfall that calcification in the mitral annulus, aortic root, aortic valve and pericardium could mimic CAC. The diagnostic criteria were based on previously documented methods used in identifying calcification as an incidental finding on CT scans[6] and were designed to be simple and easily reproducible. No attempt was made to use Hounsfield units to estimate the quantity or volume of calcification present. CAC was only diagnosed when it was apparent on an artifact-free scan and clearly visible on standardized soft-tissue windows.

RESULTS

884 consecutive thoracic MCCT scans reported by a consulting radiologist over a 7-month period we-

re retrospectively assessed. The reviewing radiologist was aware of artifacts due to either cardiac or respiratory movement. Results were evaluated with chi-square test. CAC was present in 33.6% of scans on males and 16.9% of scans on females. All 4 scans on male patients and 0 scans on female patients in the below-40 age group showed evidence of CAC.

A positive CAC incidence continued to increase for both men and women, with the scores for women lagging behind those for men by a decade. P value is for both of them lesser than 0.001 and meaningful ($p< 0.001$). Figure 1 shows a graphic display of the distribution of positive CACs by gender and age. When adjusted by pack-year, the values were essentially the same. Male subjects are more likely than female subjects to have detectable coronary up until the age of 69 year. Female subjects are more likely than male subjects to have detectable coronary calcification over the age of 69 years.

Both groups were subdivided into decades, and the presence of calcification within these groups was noted (Figure 1).

DISCUSSION

It has been shown that the majority of persons with CAC experience a reduction in life quality and cardiac diseases due to stenosis in coronary arteries at varying severities.[2,7]

In patients with no evidence of calcification, both in the first approach and later, the prevalence of ischemic heart disease is extremely low.[1,8]

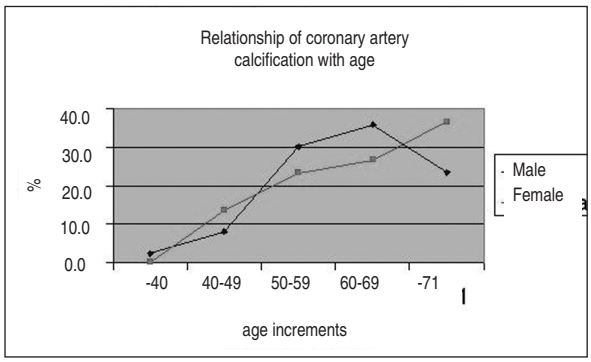

FIGURE 1: Relationship of CAC with age.

However, conventional CT has detected CAC in asymptomatic subjects with a specificity of 78–100% and a positive predictive value of 83–100%, suggesting that significant coronary artery disease is likely to be present when calcification is detected using conventional CT.[4]

In addition, some researchers found that age, gender, and all of the established causal risk factors were independently associated with calcium scores; furthermore, the calcium score increased significantly with an increasing number of risk factors.[9,10]

The presence of calcification during a standard thorax CT investigation should prompt referral for cardiological assessment, particularly as calcification often occurs in patients who have few or no cardiac symptoms.

In this study, we evaluated the incidence of CAC with respect to age and sex for persons whose thorax CTs were taken due to lung diseases such as lung cancer, solitary pulmonary nodules, or pneumonia. The incidence of CAC was found to be 33.6% for males over 20 years of age, and 16.9 for females. The CAC incidence was higher for males than for females in our study, and incidence increased with aging for both males and females. The difference between males and females decreased as age increased. After 69 years of age, the mean CAC in males decreased from 36% to 23.6% with respect to the previous decade, while it increased from 23.3% to 26.7% for females. Again the CAC percentage reached 30.3% in the sixth decade, while it was 7.9% in the fifth decade.

Table 1 show that, our findings are consistent with the results of the similar study by Callaway et al. We used 16 row-MSCT while Callaway used conventional CT. Percentages of CAC were higher in the studies which used specific software (Table 1).[11-14]

Even though there is a difference in CAC percentages due to the differences in methods, the age of CAC occurrence goes down to 30-although this

TABLE 1: Table shows "CAC incidence by gender, age range, number of patients, modality of scan and nationality of patients in the former and present study.

Researcher	Males CAC%	Females CAC%	Age range	Number of Patients	Modality	Nationality
Celenk	33.6	16.9	20-94	884	MSCT(16 sl.)	TR
Callaway	26	15.6	19-95	450	CT	UK
Cheng	65.3	29.4	20-80	17,967	EBCT	USA
Erdogan	58.9	51.1	30-85	654	EBCT	TR
*Shisen	32-62 (in between)	0-44 (in between)	17-86	953	EBCT	TJ
*Shemesh	22-54 (in between)	7-47(in between)	28-93	4250	MSCT(4-8 sl.)	IL

sl.=slice
* express different percents on decades

is rare and CAC incidence increases with age (Table 1).[4,10-14] In many studies, CAC is not found in women under 40, and is found rarely in women under 50 and 60. However, after 60 years of age, the CAC percentage increases dramatically forwomen and surpasses the male percentage after 70 years of age.

Our study, similar to other studies, reveals that CAC incidence is higher for males; however, the difference between males and females decreases as age increases, and the incidence in females surpasses the incidence in males after 70 years of age. The low percentage for females is explained by the fact that female hormones protect persons from atherosclerosis.[4] For both sexes, an increase in CAC is suggested to be related to risk factors like diabetes, smoking and obesity.

As a result, we found that CAC is more prevalent in males than in females, particularly in younger ones. This difference decreases as age increases, being parallel to the clinical manifestations of coronary artery disease.

In conclusion, since CAC incidence is high in patients with Coronary artery disease (CAD), the presence of CAC in CT cross-sections can be used as a predictor or warning for CAD. Therefore, it is important to investigate the presence of CAC when routine thorax CT graphs are evaluated.

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