Original Article

Gender and Age Differences in the Prevalence of Coronary Artery Calcification in 953 Chinese Subjects

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Available online 10 May 2005

Background: **To investigate gender and age differences in coronary artery calcium (CAC) as determined by electron beam computed tomography (EBCT) in a Chinese population.**

Methods: **Consecutive patients undergoing EBCT were subdivided into groups based on gender and decades of life. They were further subdivided into three groups with respect to symptoms of coronary artery disease: typical, atypical and asymptomatic. Total calcium score was calculated for each patient and means calculated for each subgroup. Groups were then compared with respect to age, gender and symptoms.**

Results: **During the study period, 953 patients (736 men and 217 female) aged 17–86 years (mean 55 $\pm$ 11 years) underwent EBCT. The prevalence of CAC increased significantly with increasing age. The mean total calcium score also increased with increasing age in males and females of each symptom subgroup. The prevalence of coronary artery calcification was significantly higher in males than females until age in excess of 69 years ($p < 0.05$). The prevalence of coronary artery calcification and mean calcium scores were significantly different between each symptom subgroup ($p < 0.001$) with higher scores and prevalence in patients with typical symptoms of coronary disease.**

Conclusions: **There is an increase in the prevalence of coronary artery calcification with age in Chinese subjects. Male subjects are more likely than female subjects to have detectable coronary calcification up until an age in excess of 69 years. Patients under the age of 70 years, with typical symptoms of coronary artery disease have a higher prevalence and mean calcium score than those with atypical or no symptoms.**

(Heart Lung and Circulation 2005;14:69–73)

Keywords. Coronary calcification; Chinese; EBCT

Introduction

Coronary artery disease (CAD) remains one of the major causes of mortality in Western industrialized nations. A major goal of preventive therapeutic strategies is the early detection of atherosclerosis and appropriate risk stratification. Electron beam computed tomography (EBCT) accurately detects coronary artery calcium (CAC), which indicates the presence of coronary atherosclerosis.[1,2] A number of studies[3–5] have suggested a correlation between the severity of calcification and the severity of significant anatomic CAD, however the American College of Cardiology/American Heart Association expert consensus document on EBCT[6] suggests that whilst a higher amount of calcium is associated with a higher likelihood of occlusive CAD, there is not a direct relationship and the findings may not be site specific. Previous studies in Western populations have shown an association between the presence of coronary calcium and increasing age.[5,7,8] A previous study of 163 moderate to high risk Chinese patients suggested that the coronary calcium score determined by EBCT appeared to have similar predictive value with respect to angiographic coronary artery disease as in other ethnic populations.[9] We sought to investigate gender and age differences in coronary artery calcium (CAC) as determined by electron beam computed tomography (EBCT) in a large Chinese population.

Patients and Methods

Subjects

This is a retrospective analysis of all consecutive subjects undergoing EBCT screening between February 1998 and February 1999 at Nanjing JinLing Hospital, which is a large tertiary referral hospital in the Eastern part of Nanjing, China. Patients were referred for EBCT by their specialist physician as a screening test for the likely presence or absence of coronary artery disease. Generally patients had multiple risk factors or symptoms suggestive of coronary artery disease. The males and females were then divided

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1443-9506/04/$30.00
doi:10.1016/j.hlc.2005.03.007

into five age groups: patients less than 40 years old; 40–49 years; 50–59 years; 60–69 years and greater than 69 years old. Patients were then further grouped on the basis of symptoms of coronary artery disease as determined by consensus prospectively by three experienced Cardiologists at the time of investigation: typical anginal symptoms; atypical symptoms and truly asymptomatic. Decisions about symptomatic status were based on a history and physical examination in conjunction with the results of an ECG and CXR. There was no formal documentation of cardiovascular risk factors so this data is not presented. Patients with typical symptoms generally had documented CAD or classical histories of angina. The atypical group generally had non-typical anginal symptoms where the Cardiologist felt there was insufficient information to judge the chest pain as consistent with CAD. The asymptomatic subgroup was free of any symptoms.

Computed Tomographic Image Acquisition

All EBCT studies were performed with an Imatron C-150 electron beam computed tomography scanner (Imatron, San Francisco, California). Subjects were in the supine position head first into the scanning aperture with no couch angulation. Scanning started from near the lower margin of the bifurcation of the main pulmonary artery. Coronary visualization was achieved without contrast by using the high-resolution volume mode of the electron beam CT scanner in conjunction with a 50 ms scan time, 3 mm slice thickness, electrocardiographic triggering (to 80% of the R-R interval), and two breath holds for approximately 45 s in total. Twenty to 30 contiguous slices were acquired with no interslice gaps. A computed tomographic threshold of at least 2 pixels and 130 Hounsfield units (Hu) was utilized for identification of a calcific lesion. At each level all, pixels with a CT density $\geq$130 HU were displayed. A calcium score was derived by three radiologists experienced in tomographic imaging using the Agaston method.[10]

Statistical Analyses

Where appropriate, variables are reported as mean $\pm$ 1 S.D. Categorical variables are compared with Chi square test or Fischer's exact test as appropriate. Continuous variables with a normal distribution are compared with unpaired Student's *t* test and continuous variables not normally distributed are compared with the Mann–Whitney Wilcoxon test. One way ANOVA was used to compare the three symptom groups with respect to prevalence and mean calcium score. Multivariate logistic regression analysis was performed to identify independent predictors of presence of coronary calcification (forward selection, maximum likelihood ratio method). Statistical analysis was performed using SPSS for Windows (version 10). Statistical significance was defined as a two-tailed p value of <0.05.

Results

During the study period, 953 patients (736 men and 217 female) aged 17–86 years (mean 55 $\pm$ 11 years) underwent EBCT. In terms of age spread: 80 subjects were less than 40 years; 206 were 40–49 years; 350 were 50–59 years; 223 were 60–69 years and 94 were aged in excess of 69 years of age. With respect to symptom status: 216 subjects were deemed to have typical symptoms; 209 had atypical symptoms and 528 were considered to be asymptomatic. Gender distribution by age and symptom status is presented in Table 1.

Prevalence

The prevalence of coronary calcification (coronary calcium score >1) is shown in Fig. 1 in men and women according to symptomatic status. Fig. 2 describes the increasing prevalence of coronary calcification with age irrespective of gender or symptom status ($p < 0.001$, by Pearson Chi square). The prevalence of CAC was significantly higher in males than females in the age groups <40 years (32% versus 0%; $p = 0.005$), 40–49 years (40% versus 16%; $p = 0.003$), 50–59 years (52% versus 35%; $p = 0.007$) and 60–69 years (62% versus 44%; $p = 0.027$). This difference was no longer apparent in subjects older than 69 years (80% versus 83%; p = ns). The prevalence of coronary artery calcification were significantly different between each symptom subgroup ($p < 0.001$, one way ANOVA) with higher prevalence in patients with typical symptoms (67%) of coronary artery disease than those with atypical (44%) or no symptoms (43%).

Total Calcium Score

Table 2 summarizes the results for the mean total calcium score according to symptom subgroup, age and gender. The mean calcium score increased with increasing age both in males and females regardless of symptom subgroup. Whilst mean calcium scores tended to be higher in males than females in each age and symptom group on most comparisons, there were no significant differences between genders in each age and symptom subgroup. The exception being the 60–69 year old age group where males in the typical symptom ($p = 0.026$) and asymptomatic group ($p = 0.002$) had higher scores than females. Ignoring

Table 1. *Gender Distribution by Symptom Status and Age*

	Typical, $N = 216$		Atypical, $N = 209$		Asymptomatic, $N = 528$	
Age (years)	Male, $N = 170$	Female, $N = 46$	Male, $N = 150$	Female, $N = 59$	Male, $N = 416$	Female, $N = 112$
<40	4 (2%)	1 (2%)	11 (7%)	5 (8%)	48 (12%)	11 (10%)
40–49	21 (12%)	2 (4%)	33 (22%)	9 (15%)	108 (26%)	33 (29%)
50–59	48 (28%)	16 (35%)	63 (42%)	22 (37%)	164 (39%)	37 (33%)
60–69	67 (39%)	21 (46%)	31 (21%)	19 (32%)	62 (15%)	23 (21%)
>69	30 (18%)	6 (13%)	12 (8%)	4 (7%)	34 (8%)	8 (7%)