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Research Article

Association Between Asian Ethnicity and Premature Coronary Artery Disease

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Abstract

Objectives: It is well known that Asians have an increased prevalence of CAD. This study investigated the association between the prevalence of "premature" CAD (i.e. CAD in men < 40 and women < 50) and ethnicity, with a focus on Asian ethnicity.

Methods: Our study included 1,386 young adults who underwent coronary CT angiography (CCTA) at a single institution. Ethnicity and other demographic variables were recorded. For all plaques identified on CCTA, the blood vessel and segment affected was recorded. Plaques were characterized as calcified, non-calcified, or mixed, and the degree of stenosis was assessed based on the CAD-RADS reporting system.

Results: The prevalence of premature CAD was over twice as high among Asians (p=0.003, 33.3%, 19.0%-47.6%) (Mean, 95% C.I.) compared to Whites (16.0%, 13.1%-18.8%), Blacks (12.4%, 8.5%-16.2%), and Latinos (12.3%, 9.2%-15.4%). The majority of plaques among all ethnic groups were non-calcified plaques identified in the proximal segment of the LAD. There was no relationship between ethnicity and plaque type (p=0.617) or location (p=0.788).

Conclusion: Asians are not only at an increased likelihood of developing CAD, but the atherosclerotic disease process begins at an earlier age compared with patients of other ethnicities. Atherosclerotic plaque characteristics are similar among all ethnicities.

Keywords: Asian ethnicity, coronary artery disease, coronary CT angiography, prevalence

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Coronary artery disease (CAD) is a major cause of mortality and morbidity in developed countries. Known risk factors for the development of CAD include diabetes, hypertension, high triglycerides, low HDL level, smoking history, and age.[1] Ethnicity may also play a role in the development of CAD. It has been documented that Asians have an increased prevalence of CAD and are more likely to undergo hospitalization for ischemic heart disease.[2]

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The purpose of this study was to determine if there is an association between the prevalence of premature coronary artery disease (i.e. CAD in men <40 and women <50) and ethnicity. In particular, this study determined whether the increased prevalence of CAD among the Asian population (relative to other ethnic groups) was also present among younger patients undergoing coronary CT angiography (CCTA) for the diagnosis of chest pain.

Methods

Patients

Study protocols were approved by the Institutional Review Board and the study was performed in compliance with the Health Insurance Portability and Accountability Act. The study was performed at a single, large institution in the United States. A Montage® search (Montage Healthcare Solutions, Philadelphia, PA, USA) of the imaging database found 1,420 patients, under the age of 40 for men and 50 for women, who underwent coronary CT angiography for evaluation of undiagnosed chest pain between January 1, 2016 and January 15, 2017 (Table 1). Those with the following were excluded from the study: less than age 18 and lack of demographic information (specifically, a lack of information regarding ethnicity). Information regarding ethnicity was not available for 34 of the 1,420 patients (2.4%), and the remaining 1,386 patients were included in the study (Table 2).

Table 1. Summary demographics

Variable (n=1420)	n	%
Age	Median 38 (18-50)	
Gender male	709	50
Hypertension	543	38
Diabetes	190	13
Previous stroke	46	3.2
Anxiety	260	18
Smoker	512	36
Cocaine recent	57	4
Cocaine remote	72	5
Marijuana use	146	10
Daily aspirin	318	22
Obesity >30 BMI	749	53
Framingham	Median 0.90	
Triglycerides, mg/dL	Median 120	
Total cholesterol, mg/dL	Median 173	
HDL, mg/dL	Median 44	
LDL, mg/dL	Median 97	

BMI: Body mass index; HDL: High-density lipoprotein; LDL: Low-density lipoprotein

Acquisition of Coronary CT Angiograms

A majority of patients were imaged using the SOMATOM Definition Flash (Siemens, Erlangen, Germany) or Philips Ingenuity (Amsterdam, Netherlands) 128-row CT scanners. Imaging was started 9 mm above the ostium of the left main coronary artery or top level of left anterior descending artery and continued to 9 mm below the inferior aspect of the heart. The following imaging parameters were used: 100 or 120 kVp; variable mAs; 0.28 sec rotation time; collimation, 128 x 0.6 mm; HR dependent pitch; HR dependent acquisition time. A majority of patients were scanned throughout the cardiac cycle with ECG-triggered dose-modulation. Reconstruction: 0.75 mm slice thickness, 0.5mm reconstruction spacing; 1.0 mm x 0.6 mm multiphase reconstruction generated across the ECG pulsing range every 10% of the R-R interval. Iterative reconstruction was performed. Contrast dose ranged from 80-150 mL nonionic iodinated contrast; 30 mL saline flush was used to eliminate contrast from the right ventricle; contrast injection rate was 3-6 sec; test bolus was used to calculate the peak contrast enhancement and determine the correct scan delay. Curved multiplanar reformations and volume renderings were performed on a separate workstation using TeraRecon (Foster City, California, USA).

Table 2. Demographics by ethnicity

Variable (n=1387)	White		Black		Latino		Asian		p
	n	%	n	%	n	%	n	%	
Gender, Male	330	51.6	115	*41.4*	218	50.8	23	**60.5**	0.011*
Age	Median 37		Median **39**		Median 38		Median **39**		0.252
Hypertension	222	34.7	150	**53.6**	151	35.2	8	*21.1*	<0.001*
Diabetes	62	*9.7*	50	**17.9**	67	15.6	6	15.8	0.002*
Smoker	261	**40.8**	83	*29.6*	140	32.6	13	34.2	0.004*
Obesity >30 BMI	313	49.3	168	**60.0**	236	55.4	15	*39.5*	0.005*
CAD	101	15.8	33	*11.8*	51	11.9	12	**31.6**	0.003*

Bold: Vertex; Italics: Nadir; BMI: Body mass index; CAD: Coronary artery disease. *Statistically significant difference between vertex group and combined other groups.

Table 3. CAD-RADS[13]

	Degree of maximal coronary stenosis	Interpretation
CAD-RADS 0	0% No plaque or stenosis	Documented absence of CAD
CAD-RADS 1	1-24% Minimal stenosis or plaque with no stenosis	Minimal non-obstructive CAD
CAD-RADS 2	25-49% Mild stenosis	Mild non-obstructive CAD
CAD-RADS 3	50-69% Stenosis	Moderate stenosis
CAD-RADS 4	A) 70-99% Stenosis or B) Left main >50% or 3-vessel obstructive (≥70%) disease	Severe stenosis
CAD-RADS 5	100% (Total occlusion)	Consider ICA and/or viability assessment

CAD-RADS: Coronary artery disease reporting and data system; ICA: Internal carotid artery.

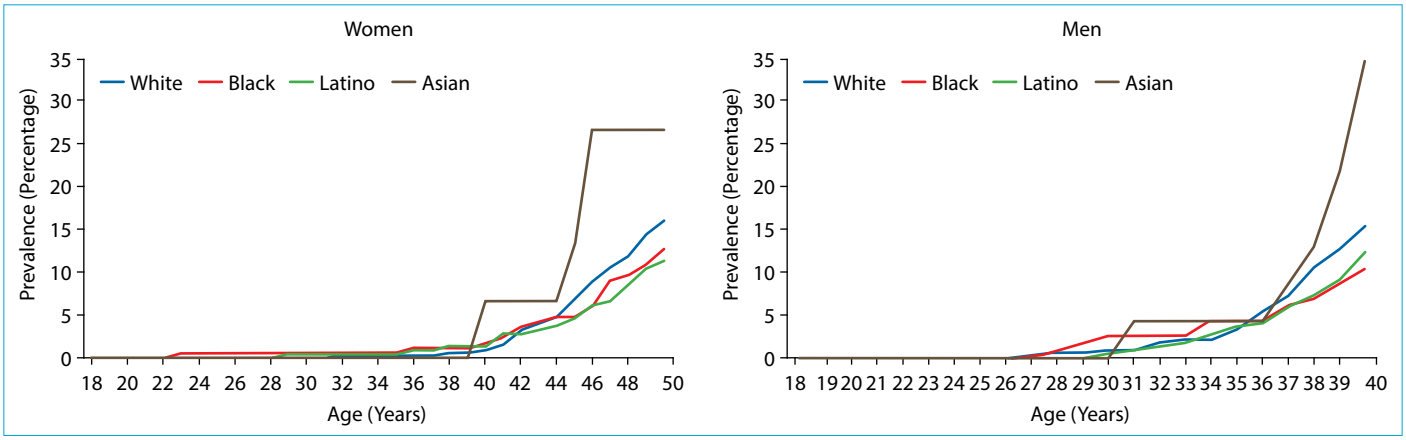

Figure 1. The prevalence of 'age advanced' CAD by ethnicity. The prevalence of CAD in this group of young adults was significantly higher among Asians compared to other ethnicities (p=0.003).

Image Interpretation

Each coronary artery was assessed based on the CAD-RADS reporting system by an experienced cardiac radiologist. The CAD-RADS reporting system allows physicians to grade the severity of coronary artery disease as outlined in Table 3. Left or right dominance was determined. The coronary arteries were divided into (1) left main, left anterior descending artery, and diagonal branches; (2) left circumflex artery and obtuse marginal branches; and (3) right coronary artery, acute marginal branches, posterior descending artery, and posterolateral branches.

For all plaques identified on CCTA, the blood vessel and segment affected was recorded. Plaques were characterized as calcified, non-calcified, or mixed and the degree of stenosis was recorded. Hemodynamically significant stenosis was defined as a CAD-RADS score of 3 or higher (≥50% stenosis).

Subject Demographic Information

Demographic and clinical information was also collected including: age, past medical history including diabetes, hypertension, or obesity, social history including current or prior history of smoking, and laboratory values including total cholesterol level, triglyceride level, LDL level, and HDL level.

Statistical Analysis

Between-group comparisons were performed with Chi-square test of independence for categorical variables and Mann-Whitney for continuous variables. Logistic regression was used to determine factors related to modeling CAD. All tests were two-tailed and a value of 0.05 was selected for statistical significance. No p-value adjustment was made for multiple tests conducted. Statistical analysis was performed with SPSS 21.0 (IBM, Armonk, NY, USA).

Results

Patient demographics are displayed in Table 1. Overall, the Asians in this study were of similar age, more often male, less often had hypertension, and were less often obese compared to the rest of the cohort (Table 2).

The prevalence of CAD in this group of young adults was over twice as high among Asians (p=0.003, 33.3%, 19.0%-47.6%) (frequency, 95% C.I.) compared to Whites (16.0%, 13.1%-18.8%), Blacks (12.4%, 8.5%-16.2%), and Latinos (12.3%, 9.2%-15.4%) (Fig. 1).

The majority of plaques among all ethnic groups were non-calcified plaques. There was no association between ethnicity and plaque type (p=0.617). Also, the majority of

plaques among all ethnic groups were found in the proximal segment of the LAD. There was no association between ethnicity and plaque location (p=0.788).

Discussion

Asian Americans are the fastest growing ethnic group in the United States. In this study, we identified an increased prevalence of premature CAD among Asian patients with undiagnosed chest pain undergoing coronary CT angiography, relative to similar aged patients of other ethnic groups. This is consistent with the increased prevalence of CAD among Asians noted among older age groups.[2] These findings suggest that Asians are not only at an increased likelihood of developing CAD, but the atherosclerotic disease process may begin at a younger age.

Previous studies have identified the Asian-Indian population as having the highest rate of CAD among all subgroups. Asian Indians have 4 times the risk of developing myocardial infarction and more severe cases of CAD.[3] Further, the mortality rate from CAD is 40% higher in Asian-Indians than in Caucasians.[4] This may be attributable to factors including a higher rate of diabetes mellitus,[5] hyperinsulinemia, low levels of high density lipoprotein, high triglyceride levels, and obesity.[6] Additionally, Makaryus et al. showed that based on conventional angiographic results, young patients of Asian-Indian background have significantly smaller coronary artery lumens than Caucasians.[7] This may alter blood flow, blood velocity, and/or shear stress, which may predispose to premature atherosclerosis.

In contrast, other studies have evaluated East Asians (i.e. Japanese and Korean populations) in comparison to Caucasians. Fujiyoshi et al. worked on a cross-sectional association of obesity with coronary calcium (CAC) among native Japanese and Koreans compared to white Americans, which demonstrated that prevalence of CAC in Japanese and Korean populations was lower than the White American group.[8] This demonstrates that East Asians may have a lower risk of CAD as opposed to the higher risk of CAD among Asian Indians, which further highlights the diversity in the Asian population overall.

Additionally, Fujiyoshi identified that the BMI and waist circumferences of Japanese Americans was greater than observed among native Japanese patients. Their BMIs and waist circumferences were actually quite similar to White Americans, and their risk of CAC among Japanese Americans was also similar to that of white Americans.[8] This highlights that the association between ethnicity and CAD is likely not only be attributable to genetic differences, but other differences such as diet and lifestyle.

Despite the vast differences among the various Asian subgroups listed above, the NIH only recently began sub-stratifying Asians into 7 distinct subgroups: Japanese, Asian Indian, Chinese, Filipino, Korean, Vietnamese, and Other Asian.[9] These subgroups are very different from one another with respect to genetic variation, cultural differences, socioeconomics, and behavioral patterns. All of these factors may influence the development of premature CAD, and appreciating these differences may allow for the identification of unique risk factors for premature CAD among each Asian sub-group.

Limitations

Like many institutions, our institution only identified patients as "Asian" but did not specifically identify the Asian sub-group to which they belonged. This did not allow for comparison of the prevalence of CAD or the risk factors predictive of CAD between the various Asian sub-groups.

Also, this was a retrospective chart review. If the distribution of missing variables was not random, the association between these variables and premature CAD may be biased. Finally, the number of Asian patients with CAD was limited. This precluded more detailed statistical analyses, such as logistic regression, to determine underlying risk factors and confounding variables among patients in each ethnic group.

Coronary artery disease (CAD) is the leading cause of death worldwide and will likely remain so for many decades. In contrast to the declining numbers in the Western world,[10] its incidence is expected to increase in other parts of the world, predominantly in Asia.[11] Physicians should be aware of the increased likelihood of CAD in young Asian patients. The pressing need for ethnicity-specific cardiovascular disease (CVD) research has recently been underlined by the American Heart Association.[12] However, it is challenging to determine which risk factors are attributable to the increased prevalence of CAD among Asians, especially because this group is extremely diverse.

In accordance with the recent NIH stratification of the Asian ethnicity into sub-groups,[9] we encourage all institutions to record more specific demographic information. For example, as opposed to identifying a patient as "Asian", it would be beneficial to record which sub-group the patient belongs to (Japanese, Asian Indian, Chinese, Filipino, Korean, Vietnamese, and Other Asian). This will allow for the identification of CAD risk factors unique to each sub-group, and permit physicians to tailor the prevention and treatment of premature CAD among Asians. Recording more detailed demographic information will likely prove beneficial among other ethnic groups as well.

Additional research in this field is needed with larger num-

bers of patients from each ethnic group. This will allow for more complex multivariate analyses to determine the degree of risk associated with Asian ethnicity relative to other risk factors and account for potential confounding variables. Future studies should also be directed towards identifying whether methods of preventing the development of CAD, such as prescribing lipid-lowering medications, should begin at an earlier age for Asian patients at risk for CAD.

Conclusion

Asians are not only at an increased likelihood of developing CAD, but the atherosclerotic disease process begins at an earlier age compared with patients of other ethnicities. Atherosclerotic plaque characteristics are similar among all ethnicities.

Disclosures

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Conflict of Interest: None declared.

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