COMPARISON OF CAROTID PLAQUE CHARACTERISTICS BETWEEN JAPANESE AND MIDWEST AMERICAN CAUCASIAN PATIENTS WITH CORONARY ARTERY DISEASE: A 3.0T MRI STUDY.

Hideki Ota[1], J Kevin DeMarco[2], Minako Wakayama[3], David C Zhu[2], Kei Takase[1], and Shoki Takahashi[1]

[1]Diagnostic Radiology, Tohoku University Hospital, Sendai, Miyagi, Japan, [2]Radiology, Michigan State University, East Lansing, MI, United States, [3]Cardiology, Sendai Red Cross Hospital, Sendai, Miyagi, Japan

Target audience: Researchers, radiologists, and clinicians imaging/treating patients with carotid atherosclerotic disease and those with multiple ethno-racial backgrounds.

Purpose: Ethnic differences in cardiovascular disease morbidity and mortality have been observed. Previous studies indicated racial differences in the presence and extent of atherosclerotic disease in various vascular territories[1]. However, there is little data comparing carotid plaque characteristics in Japanese and Caucasian populations with advanced atherosclerosis. The purpose of this study was to investigate the difference of carotid atherosclerotic morphology as determined by MR imaging between asymptomatic Japanese (Asian) and Midwest American (Caucasian) patients with coronary artery disease.

Materials and Methods: Two centers (one in Japan and the other in the United States) participated in this study. Subjects' inclusion criteria were asymptomatic >50% carotid stenosis as measured by screening Doppler ultrasound or CT angiography and history of coronary artery disease. Fifty-four male patients (Japanese, 22, American, 32) underwent carotid MR imaging on 3.0T scanners with a 2-ch or 4-ch surface coil. Multi-contrast carotid plaque MR imaging included five different weightings: 3D time-of-flight, pre-contrast T1W, T2W, magnetization prepared rapid acquisition with gradient echo and contrast enhanced-T1W performed 5-minutes after intravenous infusion of gadolinium contrast. Images were acquired in the axial plane with slice thickness of 1 to 2 mm. Scan level was set to include extracranial carotid bifurcation. Contrast-enhanced MR angiography was also performed to measure the degree of carotid stenosis. Two reviewers interpreted carotid imaging through consensus agreement based on published criteria that have been validated by histology[2]. The reviewers were blinded to subject's information. Subjects' demographic data (age, body mass index [BMI], hyperlipidemia, diabetes mellitus, statin use and smoking) were collected. For each patient, ipsilateral carotid artery with the more severe stenosis was analyzed. The extracranial carotid bifurcation level was used as a landmark for matching the five different weightings. Presence of complicated American Heart Association type VI (AHA-type VI: plaques with luminal surface defect, hemorrhage/thrombus, or calcified nodules), hemorrhage, necrotic core and calcification were recorded. Percent wall volume (wall volume/total vessel volume×100%) and % component volume (component volume/wall volume×100), if present, were documented. Log transformations were also applied for all % component volume because it was positively skewed. Lastly, two radiologists, blinded to clinical information and results of plaque imaging, evaluated the degree of diameter stenosis as measured by CE-MR angiogram based on NASCET criteria. Logistic and linear regression analyses were used to evaluate associations between these two geographic populations on carotid wall morphology controlling for demographic characteristics and MR angiographic findings as potential confounders.

Results: Among demographic data, Japanese patients demonstrated lower BMI ([mean ± SD] 22.0 ± 2.5 vs. 27.2 ± 3.8, $p<0.01$) and a trend for more highly prevalent diabetes (64% vs. 38%, $p=0.06$) than American. These variables were included as potential confounders for multivariate regression models. Between Japanese and American, degree of stenosis (63.0% ± 12.5 vs. 58.5% ± 23.0, $p=0.41$) measured with MR angiography or % wall volume ([mean ± SD] 59.7% ± 8.2 vs. 57.4% ± 8.8, $p=0.34$) was not significantly different. Japanese demonstrated higher prevalence of AHA-type VI (86% vs. 50%, adjusted odds ratio [aOR] = 6.3, $p<0.01$), hemorrhage (86% vs. 41%, adjusted aOR = 9.3, $p<0.01$) and larger % necrotic core volume ([median (25th, 75th)], 16.5% (4.1-34.9) vs. 6.5% (2.9-14.0), coefficient for log % volume = 0.3, $p=0.043$). There was a mild trend for more highly prevalent necrotic core (95% vs. 78%, aOR=5.0, $p=0.12$) in Japanese. The prevalence and size of calcification was not significantly different between two ethnics.

Discussion: A large international epidemiological study that enrolled outpatients with either established atherosclerotic disease or at least 3 risk factors of atherosclerosis (the Reduction of Atherothrombosis for Continued Health [REACH] Registry) indicated that there were some geographic differences in baseline patient's characteristics as well as prevalence of major cardiovascular and cerebrovascular events in one-year follow up[3]. The study demonstrated higher prevalence of obese patients (BMI ≥ 30) in North America than Japan (41% vs. 4%), which was comparable to our patients' baseline characteristics. Japan has lower rates of cardiovascular death and of nonfatal myocardial infarction but higher rates of nonfatal stroke compared with North America. Previous reports indicated that high-risk carotid plaque characteristics that were associated with future stroke included presence of AHA-type VI lesion, hemorrhage and larger size of necrotic core. The higher rate of stroke in Japan in patients with atherothrombosis may be associated with higher prevalence of high-risk carotid plaque as indicated by the present study.

Conclusion: In this population with advanced atherosclerosis, Japanese patients were more associated with high-risk carotid plaque features than Americans. This study also indicated that carotid MR imaging could be used as an imaging technique for patient management as well as multicenter clinical trials of atherosclerosis based on the difference in race or lifestyle.

References:
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Case Presentation

75-year-old Japanese male. BMI=20.

T1W   CE-T1W   T2W   MPRAGE   TOF

MR images demonstrate hemorrhage (yellow) in the right internal carotid artery.

74-year-old American male. BMI=30.

T1W   CE-T1W   T2W   MPRAGE   TOF

MR images demonstrate calcification (white) in the right internal carotid artery.

*Contours: red, luminal boundary; light blue, outer wall boundary.