Subclinical Carotid Atherosclerosis by MRI is associated with Coronary Atherosclerosis Measured by CT and MRI: Initial Results

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Introduction:

Subclinical carotid atherosclerosis is associated with the risk of stroke and myocardial infarction. MRI can directly image carotid and coronary atherosclerosis. We investigated black-blood MRI of the carotid arteries in older patients without cardiovascular disease who also had coronary atherosclerosis assessed by black-blood coronary MRI and CT coronary artery calcium (CAC).

Methods:

Patients: A cohort of 1,023 older patients (age 60-72 years, mean age 65.8±2.8 years, 38% women, and 33% non-white) without a history of cardiovascular disease receiving care at Kaiser Permanente of Northern California was enrolled for the study. A subset of 60 patients (age 62-72 years, 22% female) who had both carotid and coronary MRI as well as CAC underwent quantitative analysis.

Carotid MRI: Black-blood proton-density and T2-weighted carotid wall images were acquired on a 1.5T MR scanner without cardiac gating using a multislice double inversion-recovery 2D fast spin-echo sequences [1] according to the previously described protocol[2] (TR=2500 ms, TE=8.5/50ms, TI=280 ms, NEX=1, Matrix=512x512, FOV=14 cm, slice thickness=3.0 mm, 0.27 mm resolution,11 slices around bifurcation centered at the bifurcation)

Coronary MRI: Coronary wall images of the right coronary artery (RCA) in cross-section were acquired using a gated, breathheld spiral black-blood coronary MRI sequence (0.7 mm resolution, 3 slices).

MR image analysis: MR measurements of the lumen area (LA) and outer vessel wall area (VA) were performed using the QVAS software (carotid) and a custom-designed image analysis tool (coronary). Wall area (WA) was calculated as WA=VA-LA. Average wall thickness (WT) was calculated assuming as circular vessel shape. For carotid MRI, mean wall area, wall thickness, and total wall volume (WA multiplied by slice thickness) of the both carotid arteries (for a total of 22 slices) were also calculated.

CT: CAC quantification was performed on a multi-detector CT scanner with prospective ECG-gating using the Agatston scoring method.

Results:

In a subset of 60 patients, mean VA, LA, and WA of carotid arteries were73.4±14.4 mm^2, 35.2±9.7 mm^2, 38.2±8.0 mm^2, and 1.4±0.2 mm and those of coronary artery were 31.6±7.9 mm^2, 9.0±3.3 mm^2, 22.6±5.8 mm^2 and 1.5±0.3 mm. Mean CAC was 291±646 and median CAC was 35 (interquartile range 4 to 226). There was a significant correlation between carotid WT and both coronary WT and CAC (r=0.33, p=0.01 and r=0.29, p=0.03, respectively). Overall carotid atherosclerosis burden, as measured by total wall volume, correlated significantly with coronary WT (r=0.3, p=0.02), but not with CAC (r=0.2, p=0.1).

Conclusions:

In an older community-based cohort without cardiovascular disease, MRI measurement of carotid atherosclerosis was associated with coronary atherosclerosis by both MRI and CT. Black-blood vessel wall MRI of the carotid and coronary arteries can assess subclinical atherosclerosis in older patients and prospective data are needed to determine the potential for predicting clinical events.

References:

1. Yarnykh VL, Yuan C. Multislice double inversion-recovery black-blood imaging with simultaneous slice reinversion. J Magn Reson Imaging 2003; 17: 478-483.
2. Yarnykh VL, Terashima M, Hayes CE, et al. Multicontrast black-blood MRI of carotid arteries: comparison between 1.5 and 3 Tesla magnetic field strengths. J Magn Reson Imaging 2006;23(5):691-698.

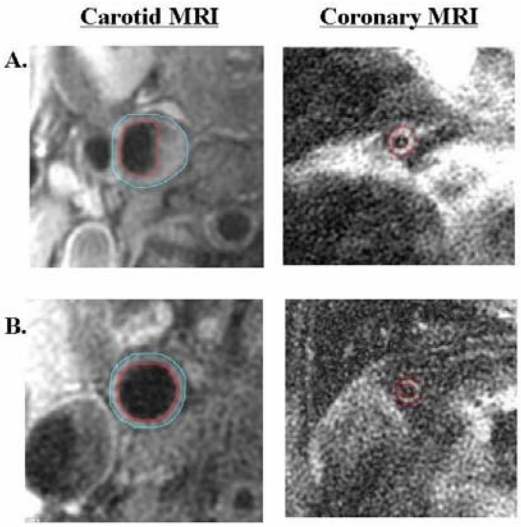

Fig 1. Representative MR images of carotid and coronary wall. A. carotid VA=119.7 mm^2, LA=59 mm^2, WA=60.7 mm^2, and WT=1.8 mm; coronary WA=27.9 mm^2 and WT=1.7 mm, B. carotid VA=73.3 mm^2, LA=36.4 mm^2, WA=36.9 mm^2, WT=1.4 mm; coronary WA=25.7 mm^2, WT=1.4 mm.

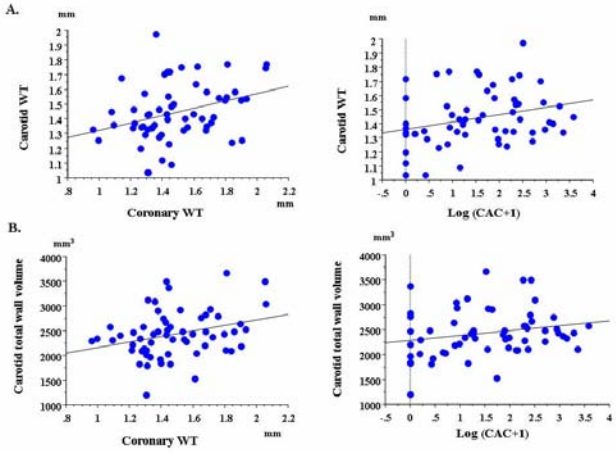

Fig 2. A. Carotid WT correlated with coronary WT and CAC (r=0.33, p=0.01 and r=0.29, p=0.03, respectively). B. Carotid total wall volume correlated with coronary WT ((r=0.3, p=0.02), but not with CAC (r=0.2, p=0.1)