MRI detects increased coronary wall thickness in asymptomatic individuals: The Multi-Ethnic Study of Atherosclerosis (MESA)

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Introduction: Black blood coronary arterial wall magnetic resonance imaging (MRI) has been developed to directly assess coronary artery wall thickness as a measure of plaque burden.[1,2] The technique is noninvasive and without radiation exposure or contrast agent injection. There is a good correlation between MRI-measured coronary wall thickness and matched histopathology sections for human coronary artery specimens and in vivo animal models($r=0.94$)[3] with good reproducilibty.[4,5] The purpose of this study was to describe the application of coronary wall MRI as a measure of atherosclerotic disease burden in an asymptomatic population of the Multi-Ethnic Study of Atherosclerosis (MESA).

Materials and Methods: Study participants were part of the Multi-Ethnic Study of Atherosclerosis (MESA).[6] In brief, participants were 45 to 84 years old and free of clinically apparent cardiovascular disease at the time of their initial enrollment into the MESA study. 11 subjects were evaluated using a 1.5 T whole-body MRI system (Signa CVi, General Electric Medical Systems, Waukesha, WI) . 39 subjects were imaged on a 1.5T whole-body clinical scanner (Avanto, Siemens Medical Solutions, Erlangen, Germany). A coronary magnetic resonance angiogram (MRA) was initially acquired. For black blood coronary MRI, seven cross-sectional slices at 5 mm intervals were obtained from the proximal portions of the coronary arteries (left main coronary artery (LM), left anterior descending coronary artery (LAD) and the right coronary artery (RCA)). Each cross-sectional image was individually prescribed based on double oblique multiplanar reformations to be orthogonal to the local longitudinal axis of the coronary wall. Cross-sectional slices were positioned based on a fixed distance from coronary landmarks rather than through areas of coronary artery narrowing. A spectrally selective fat suppression pulse was also used to increase the contrast between the vessel wall and the epicardial fat. Imaging parameters were TR = 2 R-R intervals, TE = 33 ms, echo train length = 13, bandwidth = 305 Hz/pixel, matrix = 416x416, field of view = 420 x 420 mm; slice thickness = 5 mm (Figure 1). Coronary wall images were analyzed using VesselMASS software (Leiden University Medical Center).

Results: Participants with two or more risk factors for coronary artery disease (CAD) had higher mean and maximum coronary wall thickness compared to participants with one or no risk factors (maximum wall thickness: 2.59 ± 0.33 mm versus 2.36 ± 0.30 mm, respectively, $p=0.05$). The maximum coronary wall thickness of the left main coronary artery in participants with HDL cholesterol < 40 mg/dl was significantly higher compared to participants with HDL ≥ 40mg/dl (2.71 ± 0.0.44 mm versus 2.46 ± 0.33 mm, respectively, $p=0.05$). The mean coronary wall thickness of the left main coronary artery with a history of smoking was significantly higher compared to participants who never smoked (2.10 ± 0.39 mm versus 1.78 ± 0.29 mm, respectively, $p=0.02$).. For participants with zero calcium score and two or more risk factors for CAD, the coronary wall thickness was significantly greater for those with 1 or no risk factors (mean thickness: 1.95 ± 0.17 mm versus 1.70 ± 0.19 mm; maximum thickness: 2.67 ± 0.24 mm versus 2.32 ± 0.27 mm, respectively, $p <0.05$). Participants with carotid intimal-medial thickness (IMT) more than one standard deviation above the mean (1.09 mm) had higher mean and maximum coronary wall thickness compared to participants with carotid IMT less than or equal to one standard deviation above the mean (e.g. mean coronary thickness 1.99 ± 0.14 mm versus 1.76 ± 0.21 mm, respectively, $p< 0.05$) (Figure 2). Linear regression analysis showed that increased mean coronary wall thickness was positively associated with increased carotid IMT for all vessels com

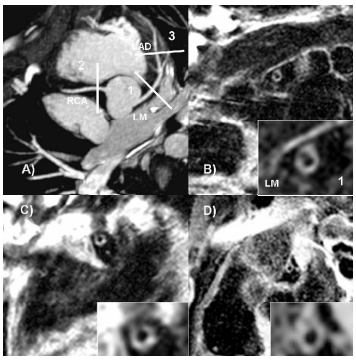

Fig 1. 73 year-old male participant, Agatston score = 200 and increased coronary wall thickness.

Conclusion:

Coronary artery wall MRI detects increased coronary wall thickness in asymptomatic individuals with subclinical markers of atherosclerotic disease and in individuals with zero calcium score.

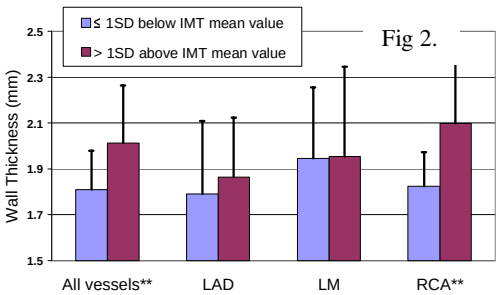

Fig 2.

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