# Editorials

## The Case Against Coronary Artery Calcium Scoring for Cardiovascular Disease Risk Assessment

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**See related** USPSTF at https://www.aafp.org/afp/2019/0115/od1.html and related Practice Guideline at https://www.aafp.org/afp/2019/0501/p589.html.

The 2018 American College of Cardiology/American Heart Association (ACC/AHA) guidelines on the management of blood cholesterol endorsed the coronary artery calcium score as a tiebreaker in the decision to withhold, postpone, or initiate statin therapy for adults at intermediate or borderline risk of atherosclerotic cardiovascular disease (ASCVD).[1] We disagree and will make a case against the use of coronary artery calcium scoring for any reason.

Consider a typical scenario of a 55-year-old white man who takes no medications and does not smoke. His systolic blood pressure is 140 mm Hg, and his total cholesterol is 220 mg per dL (5.70 mmol per L), low-density lipoprotein (LDL) cholesterol is 140 mg per dL (3.63 mmol per L), and high-density lipoprotein cholesterol is 40 mg per dL (1.04 mmol per L), yielding a baseline 10-year ASCVD risk between 5.6% if you are using the Multi-Ethnic Study of Atherosclerosis (MESA) risk calculator (https://www.mesa-nhlbi.org/CAC-Tools.aspx) and 8.8% using the ACC/AHA risk calculator (https://www.mdcalc.com/ascvd-atherosclerotic-cardiovascular-disease-2013-risk-calculator-aha-acc). The MESA score is the only cardiovascular risk calculator that provides a score with, and without, coronary artery calcium values that has been validated in a large prospective sample.

In addition to counseling the patient on lifestyle changes, the clinician engages him in shared decision-making about initiating statin therapy. Using the MESA risk calculator, the clinician explains that the patient's risk of having an event is approximately 6% over the next 10 years, but it can be lowered to approximately 4% if he takes a moderate-dose statin (number needed to treat [NNT] = 50). The patient remains undecided about starting a statin because of concerns related to taking medicine in general and the inconvenience and cost of taking a daily pill for the rest of his life.[2] The U.S. Preventive Services Task Force guidelines recommend a statin for patients with one risk factor and a risk score of 10%[3]; therefore, the clinician suggests a coronary artery calcium test be performed for the patient as an added decision-making tool.

Based on data from a MESA cohort study,[4] without knowing the coronary artery calcium score the patient's risk could change from approximately 6% to between 3% and 11% with the coronary artery calcium score included, and the anticipated NNT of statin therapy could change from approximately 50 to between 30 and 100. The most likely outcome of coronary artery calcium testing for this patient is a coronary artery calcium score greater than 0, and his absolute risk of having an ASCVD event would not be significantly altered. There is a 44% chance that his coronary artery calcium score would be 0 and his estimated risk for an ASCVD event would lower to approximately 3%. However, this patient could still benefit from statin therapy with an approximate NNT of 100. Therefore, it is unclear if knowing the coronary artery calcium score would improve decision quality or adherence to statin therapy. The tenets of behavioral psychology would suggest no improvement.[5] The notion that a coronary artery calcium score makes the decision easier or "black and white" is a gross oversimplification with many caveats that are outside the bounds of this editorial.

Although supporters of using the coronary artery calcium score presume that knowledge of elevated coronary artery calcium or a score of 0 would facilitate the initiation of and long-term adherence to statins if the patient is at high risk or deferral if he is at low risk, the guideline recommendations to incorporate coronary artery calcium testing are not based on any data of hard clinical outcomes.[1] Adherence to statin therapy, even in the presence of known coronary artery disease, is poor.[6] The recommendation to withhold statins if the coronary artery calcium score is 0 is based on observational studies that found associations of low event rates with a score of 0, but these associations were never tested in a randomized controlled trial.[6-9] The lack this type of data for coronary artery calcium testing stands in contrast to numerous statin trials showing reductions in the rates of major cardiac events in these patients.[7]

Proponents also argue that the coronary artery calcium score helps reclassify patients up or down in the risk of cardiovascular disease relative to the pooled cohort equation (e.g., ASCVD Risk Estimator). Data from the MESA cohort of 5,185 people were used to conclude that adding the coronary artery calcium score to the risk estimator resulted in a better prediction of ASCVD events.[8] Coronary artery calcium scores correctly reclassified 18% of people with events and incorrectly classified 6% of those without events. The problem is that many more people do not have events. In absolute terms, the number of people reclassified incorrectly is much higher than the number reclassified correctly. For example, 58 (18%) of the 320 people with events were correctly reclassified by coronary artery calcium score; however, 292 (6%) of the 4,865 people without events were incorrectly reclassified. Therefore, if a person is reclassified to a higher risk group with coronary artery calcium vs. the pooled cohort equation alone, there is an approximately one in six chance the reclassification is correct, and a five in six chance it is incorrect.

Potential harms from coronary artery calcium testing include radiation exposure (approximately 1 mSv; higher for patients with a body mass index greater than 30 kg per m$^2$), incidental findings in up to 40% of scans,[9,10] misdiagnosis,[11] and downstream testing. Although experts do not recommend that coronary artery calcium tests should start a cascade of downstream testing, we routinely see asymptomatic people referred for stress testing, which often leads to coronary angiography and interventions. Percutaneous revascularization does not improve outcomes over optimal medical therapy[12]; therefore, it is likely that most interventions that result from coronary artery calcium testing represent overtreatment and incur potential harm. Coronary artery calcium testing for cardiovascular disease risk assessment also goes much farther than an LDL cholesterol test or a risk calculator. For some patients, knowing they have calcium in their coronary arteries makes them believe they have heart disease, which can be life changing.

Let's return to the 55-year-old white man undergoing a coronary artery calcium test who is hoping for a score of 0 to avoid taking a statin. Instead, the coronary artery calcium score was less than 100 but showed a focal area of calcium in a proximal coronary artery. The patient started a statin

to reduce his cardiovascular disease risk, but now every palpitation or period of dyspnea during exercise raises thoughts about angina and death.

Although coronary artery calcium testing may slightly improve future risk prediction, this theoretical benefit is outweighed by its potential harms. Atherosclerosis is a complex lifelong disease, and wrongly simplifying it with coronary artery calcium testing helps the testers more than the tested.

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