Coronary Calcium Scoring: A new tool in the fight against Coronary Artery Disease

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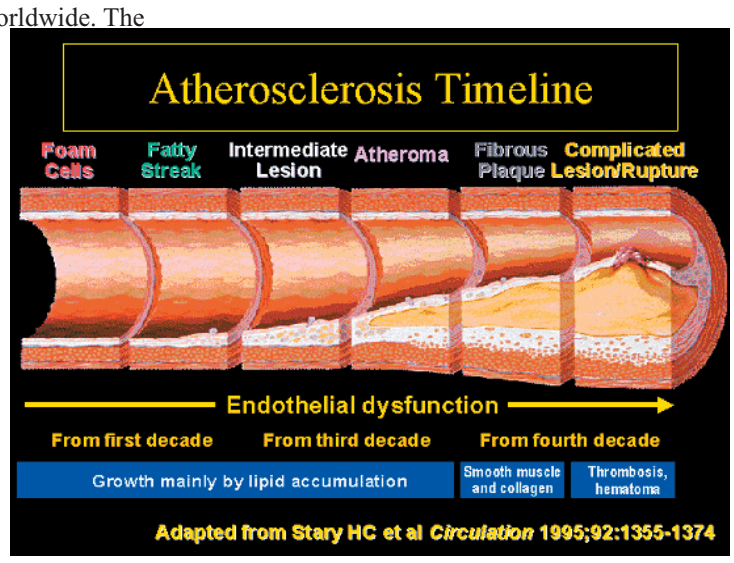
Introduction

Heart attacks are the leading cause of death among men and women worldwide. The precursor to a heart attack (or myocardial infarction (MI)) is a build up of plaque in the coronary arteries (coronary artery disease or CAD) which can rupture and form a clot in the vessel. Over the past 60 years, tremendous advances in cardiac medicine have allowed us to determine the risk factors which predispose patients to develop CAD and MI. These risk factors include high cholesterol, hypertension, a history of tobacco use, diabetes, obesity, and a positive family history for CAD. Many patients are referred to cardiologists to assess their potential risk of developing CAD. Traditionally, risk assessment has centered around screening for the aforementioned traditional risk factors as well as through noninvasive tests such as an electrocardiogram (ECG) and stress testing. However, traditional noninvasive tests such as ECG and stress testing have limitations in detecting early CAD and generally detect advanced stages of CAD. A newer modality has now emerged (coronary calcium scoring) which allows us to detect early CAD before the plaques have become severe enough to cause significant blockages and may allow for more aggressive preventative treatment and hopefully can lead to decreased risk of developing severe CAD or MI.

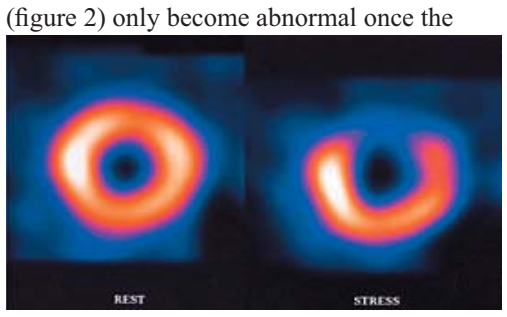


Coronary Artery Disease

Patients who have the risk factors mentioned above are at risk for developing plaque in the coronary arteries (atherosclerosis) (Figure 1). These plaques can begin to develop during the first decade of life and progress over time in a clinically silent fashion until either the blockages become severe enough to decrease the blood flow in the heart, leading to symptoms of chest pain (angina), fatigue, or shortness of breath; or until the plaques rupture causing clot to form in the arteries causing a heart attack. Traditional stress testing identifies significant CAD that has progressed to cause significant narrowing of the coronary arteries, usually blockages of at least 50%. Coronary Calcium Scoring is a noninvasive test that detects plaque buildup before it has reached this advanced stage and may be helpful in identifying patients at risk of developing CAD/MI.

Traditional Risk Assessment/Limitations of stress testing

As mentioned above, traditionally doctors interested in screening patients who had significant risk factors for CAD would perform an ECG as a baseline test and possibly would order a stress test. Stress tests (figure 2) only become abnormal once the

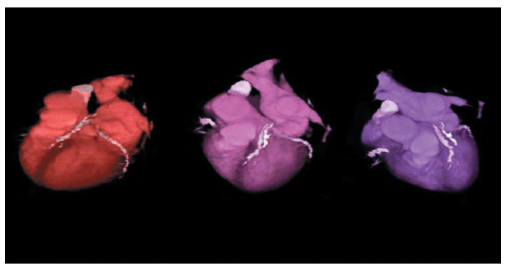


blockages in the arteries have significantly progressed (>50-70% stenosis) and can also have false positive results in patients at low risk or false negative results in patients at high risk who have significant blockages. The are not designed to pick up early disease. Bill Clinton (figure 3) had several normal stress tests during his presidency, yet soon after leaving office was found to have significant CAD which required quadruple bypass surgery after he was admitted to

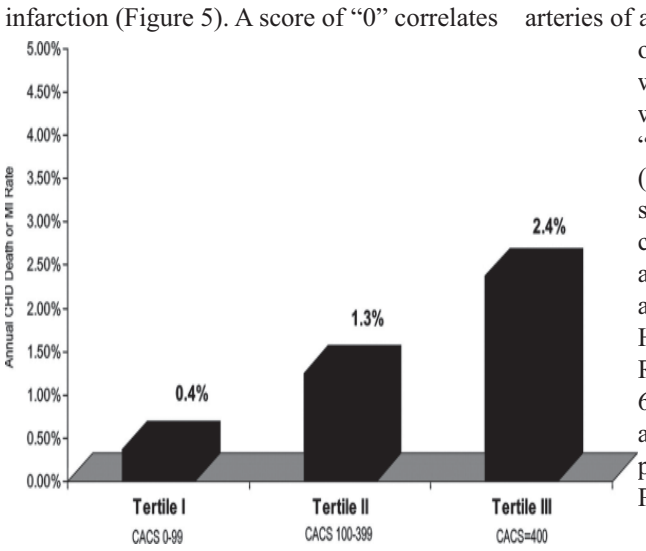
the hospital complaining of chest pains. These limitations led to the development of tests such as the calcium score to attempt to identify earlier CAD before it had progressed to the point where significant blockages had formed.

Coronary Calcium Scoring: what exactly is a "calcium score?"

The Calcium Score discussed above is determined by performing a CT Scan of the heart (figure 4) . Many atherosclerotic lesions



contain calcium, and these are detected as bright spots on the CT, even before the coronary artery has developed a significant blockage. The test is easy to perform , does not require finger stick or an IV, takes less than 15 minutes, is done with low doses of radiation, and does not require the use of contrast injection. Depending on the amount of calcium detected, you are assigned a "calcium score" or "Agatston score" named after the pioneer who developed the technology Dr. Arthur Agatston - interestingly Dr. Agatston was also the creator of the "South Beach Diet"! The score correlates with your annual risk of death/myocardial infarction (Figure 5). A score of "0" correlates



with an annual risk of 0.4% whearas a score of >400 correlates with an annual risk of 2.4%. The calcium score may also be used adjunctively with stress testing to help evaluate patients with "normal" stress tests who are symptomatic and may have a falsely negative result. In these instances, a high calcium score in a symptomatic patient with a "normal" (or falsely normal) stress test may prompt your physician to undergo a more extensive evaluation with invasive tests such as a cardiac catheterization. In general, the calcium score is used to help assess your overall risk of CAD/MI and can be useful in determining if some patients would benefit from aggressive medical therapy to help decrease their risk of future MI or death. Medications such as aspirin and cholesterol drugs known as statins are mainstays of therapy and can significantly decrease your risk of CAD/MI.

A recent study showed that patients with a calcium score of zero have extremely low risk of progression over the next 4-5 years. Although no specific data is available on how often a calcium score should be performed, it is generally a good idea for patients with known risk factors to undergo a baseline screening calcium score and consider repeating the study in 5 years.
The decision to pursue more aggressive invasive testing with cardiac catheterization is usually a clinical decision reached after your physician has performed a thorough history and physical exam in conjunction with noninvasive testing ; although invasive testing is usually reserved for symptomatic patients thought to have significant blockages.

A Famous Patient

A 48 year old man with a strong family history and multiple cardiovascular risk factors sought his physician's advice and was given a recommendation for a calcium score. He had no active symptoms at the time and his score was 210, indicating that he had the arteries of a 78 year old man. He was placed on intensive medical therapy and was under the care of his physician, with good results. His LDL, or "bad" cholesterol was under control (68). At age 58, he underwent a stress test and passed with flying colors. 6 weeks later, he died of a massive heart attack at work. His name was Tim Russert (figure 6), the popular anchor of the news program "Meet the Press".

Conclusion

Could either of our famous patient's outcomes been different? Possibly if Bill Clinton had undergone a calcium score at an earlier age (if it were available) then his physician could have identified early CAD at a point where intensive medical therapy could have prevented progression of disease and maybe led to significant lifestyle modification which could have averted the need for his subsequent quadruple bypass surgery and later coronary stent procedure several years later when one of his bypass grafts failed. Perhaps Tim Russert could have undergone a repeat calcium score 5 years after his initial study that may have indicated significant progression and led to further invasive testing, although it is not clear that this would have prevented his death.

What we do know is that the calcium score appears to be an excellent test to help determine the future risk of developing myocardial infarction/cardiac death. Using the calcium score to help guide intensive preventative medical therapy may lead to reduced rates of advanced CAD/MI and in certain patients with high risk features and/or symptoms it may help guide physicians to more aggressively evaluate patients who would benefit from invasive procedures such as cardiac catheterization or revascularization. We are in an age where medical therapy now has shown to be as effective in some studies as revascularization, and more aggressive/ intensive therapies directed at younger patients at risk identified by such modalities as calcium scoring will lead to overall reduced rates of cardiovascular death.
If you have significant risk factors for CAD or a positive family history of CAD/MI it is important that you have baseline screening for hypertension, high cholesterol and diabetes. A calcium score is emerging as an important test you may want to consider after discussion with your physician.

How important is calcium scoring? As a practicing cardiologist who leads a busy life and has a positive family history, I, at age 39, am scheduled for my first calcium score tomorrow morning in our office. I'm keeping my fingers crossed that my score is a big fat "ZERO"!

About The Author

Dr. Klemis is a cardiologist with the Stern Cardiovascular Center who specializes in prevention and treatment of coronary artery disease. He recieved advanced training in interventional cardiology at the Lenox Hill Heart and Vascular Institute of New York and has performed over 5000 cardiac and vascular procedures and is board certified in internal medicine, cardiovascular disease, interventional cardiology, vascular medicine, and endovascular intervention. If you would like to schedule an appointment in either the Germantown or Southaven office, contact him at 901-271-1000.