NONINVASIVE DIAGNOSIS OF CORONARY ARTERY DISEASE: WHICH TEST WHEN?

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Background

A 61-year-old male with a history of dilated cardiomyopathy, nonobstructive coronary artery disease (CAD), ventricular tachycardia, previous stroke, chronic obstructive sleep apnea (COSA), hypertension, hypercholesterolemia, and obesity presented to our outpatient cardiology clinic secondary to mild dyspnea on exertion and palpitations.

Interestingly, he had been followed in our clinic for more than 20 years because of a dilated cardiomyopathy believed to result from incessant ventricular tachycardia and alcohol. Serial echocardiograms revealed an initial LVEF of 27% that had improved to 46% on his most recent study, which was performed one year prior to his current visit. His last hospitalization for heart failure had occurred eight years ago. His last coronary angiogram, performed five years ago, revealed mild plaques in the left coronary arteries without focal stenosis, 30% in the mid-right coronary artery, and diffuse 60% stenosis in the posterior descending artery; therefore, medical treatment was recommended. An electrophysiology study, performed 15 years ago, revealed inducible ventricular tachycardia both during the study and with exercise. Amiodarone was initiated at that time, with resolution of both his symptoms and the inducible ventricular tachycardia.

He had been hospitalized 16 years ago due to an embolic stroke. The source was believed to be an apical LV thrombus, which was seen on his echocardiogram at that time. He was treated with warfarin for five years. This was discontinued after resolution of both the apical thrombus and the apical wall motion abnormality. He was receiving continuous positive airflow pressure therapy (CPAP) for his COSA at the discretion of his pulmonologist. Minor adjustments in his CPAP settings had been made over the years as indicated by his symptoms and follow-up sleep studies.

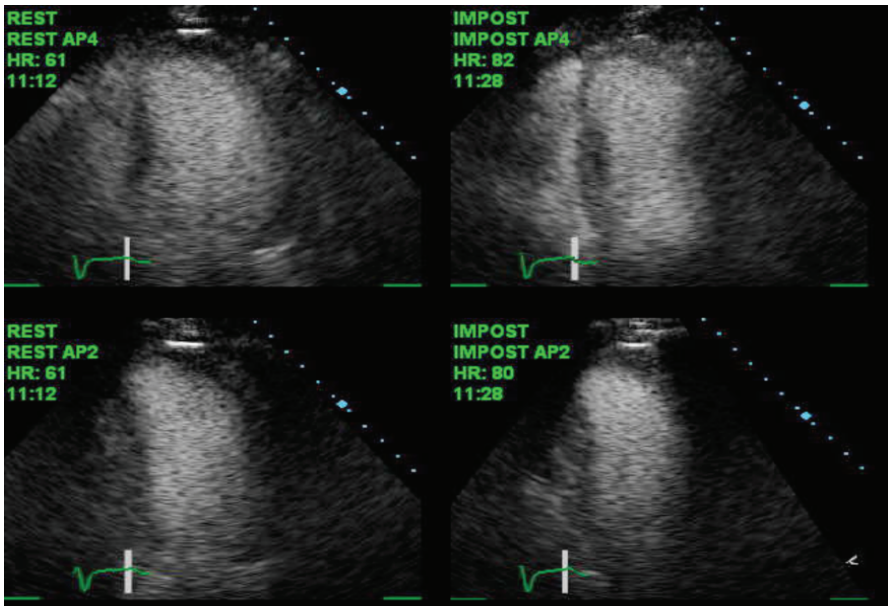

Figure 1. Parasternal and apical views of rest and stress echo images reveal an apical defect at rest that does not change after treadmill exercise (arrows).

Physical exam revealed a well-appearing obese male (BMI 38.6 kg/m^2) in no acute distress. His vital signs were normal (blood pressure 124/73; pulse 64). There was no evidence of jugular venous distention. His carotid impulses were normal and bruits were not heard. His cardiopulmonary exam was normal. Likewise, his abdominal and extremities exams were normal. His electrocardiogram revealed normal sinus rhythm at 63 bpm, first-degree atrioventricular block, interventricular conduction delay, and poor R-wave progression. His routine laboratory studies revealed normal complete blood counts, normal comprehensive metabolic panel except for an elevated fasting glucose, total cholesterol of 165, triglycerides 211, HDL 35, and LDL 88.

Because of his complex past cardiac history and his mild symptoms, the patient was sent to the stress echocardiography suite for a treadmill stress echocardiogram. He completed four minutes and 34 seconds of the Bruce protocol and stopped because of fatigue and

shortness of breath, obtaining just 55% of his maximal predicted heart rate. The stress electrocardiogram revealed occasional premature ventricular contractions and minimal (<0.5 mm) ST depressions at peak stress. His echocardiogram images as shown in Figure 1 revealed apical hypokinesis at rest and immediately after treadmill exercise. The overall interpretation of the treadmill stress echo was equivocal because of the sub-maximal level of exercise, since the findings could be compatible with either scar or ischemia in the apex. The patient was therefore referred for CT coronary angiography, which revealed a moderately calcified plaque in the mid-left anterior descending artery (LAD) without significant stenosis and a small, diffusely diseased distal LAD (Figure 2). His right coronary artery had scattered, nonstenotic, calcified and noncalcified plaques (Figure 2). His circumflex coronary artery was normal (Figure 2).

The patient was treated medically, and at his annual follow-up visit he continued to note mild dyspnea on exertion and minimal palpitations. A follow-up resting echocardiogram revealed an LVEF of 55% and normal wall motion.

The Role of CT Angiography in Diagnosing CAD

The role of CT angiography in the diagnosis of CAD has been extensively debated. Recently, a multicenter trial comparing CT angiography to conventional angiography for detecting coronary stenoses greater than 50% in symptomatic patients revealed a sensitivity of 85%, specificity of 90%, positive predictive value of 91%, and a negative predictive value of 83%. Both CT and invasive angiography similarly identified patients who needed to undergo revascularization in this study. The authors concluded that because the sensitivity, specificity, positive predictive value, and negative predictive value were not 100%, CT angiography should not replace invasive angiography in this patient population.[1]

Some other suggested roles for CT angiography include: 1) evaluation of suspected coronary anomalies,[2] 2) evaluation of the coronary arteries as part of a pre-op clearance in patients undergoing aortic aneurysm or dissection repair,[3] 3) evaluation of the coronary arteries in patients with equivocal stress test results, especially if the patient has had previous complications with invasive coronary angiography or if the clinical suspicion for subsequent revascularization is low.[4] Our patient fulfilled the third criteria — he was high risk based on his numerous cardiac risk factors. However, because of his complex past medical history, his nonspecific symptoms could have been attributed to multiple different disease processes, and his treadmill stress echocardiogram was equivocal. CT angiography, through delineation of his coronary anatomy, allowed a complete non-invasive approach to treating his coronary artery disease.

References

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Figure 2. CT angiography images of the left anterior descending artery (LAD), diagonals of the LAD (DIAG), left circumflex (CRX), and right coronary artery (RCA), respectively.