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Original Research Article

Utility of coronary CT angiography in outpatients with hypertrophic cardiomyopathy presenting with angina symptoms

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ABSTRACT

Background: Angina is a frequent symptom in patients with hypertrophic cardiomyopathy (HCM); however, it is often not because of significant epicardial coronary artery stenosis. Coronary CT angiography (CCTA) is an excellent modality to rule out significant coronary artery stenosis in the low- and intermediate-risk patients; however, its value in patients with HCM has not been explored. We sought to assess the utility of CCTA in the assessment of patients with HCM and stable anginal symptoms and compare the incidence of epicardial coronary artery stenosis to an age- and gender-matched control group.

Methods: Consecutive outpatients with HCM referred for CCTA over a 3-year period because of stable anginal symptoms (chest pain or shortness of breath) were identified retrospectively. Age- and gender-matched patients without HCM referred for CCTA because of similar symptoms over a 6-month period were used as controls. All patients had CCTA using an Aquilion ONE 320 scanner. The coronary arteries were evaluated independently by 2 blinded observers, and any luminal narrowing was scored quantitatively as follows: >70% = severe; 50% to 70% = moderate; <50% = mild; and none. For the HCM group, results of cardiac single-photon emission CT (SPECT) or cardiac magnetic resonance perfusion studies as well as catheter angiograms were recorded where available.

Results: A total of 91 patients with HCM and 91 controls were included. No significant difference in cardiac risk factors was present between the 2 groups. The CCTA was of diagnostic quality in all patients. The median (interquartile range) calcium score was lower in patients with HCM (0 [0–50] vs 2 [0–189]) but did not reach statistical significance ($P = .23$). The incidence of moderate-to-severe coronary artery stenosis was significantly lower in patients with HCM than in controls (6.6% vs 33.0%; $P < .001$). The incidence of left anterior descending artery luminal narrowing overall was also significantly lower in the HCM patients (7.0% vs 20.9%; $P = .002$). There was a higher incidence of myocardial bridging in patients with HCM (40.7% vs 6.6%; $P < .001$), with longer and deeper bridged segments. Among a subgroup of HCM patients (n = 24) who had

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either stress perfusion CMR or cardiac single-photon emission CT studies performed, 15 of 24 had false-positive perfusion abnormalities without evidence of luminal obstruction on CCTA. *Conclusion:* We demonstrate the use of CCTA for the assessment of stable anginal symptoms in patients with HCM. The incidence of moderate-to-severe coronary artery stenosis was significantly lower in our HCM patients in comparison to our age-matched, gender-matched, and risk factor–matched control group. Given the high incidence of false-positive findings on perfusion stress studies, we propose that CCTA may be useful for appropriate triage to coronary angiography in the HCM patient with anginal symptoms.

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1. Introduction

Hypertrophic cardiomyopathy (HCM) is a common familial heart disease affecting 1 in 500 people in the general population.[1] It is characterized by hypertrophy of the left ventricular myocardium in the absence of any identifiable cause.[2,3] Chest pain is a common symptom and can be due to atherosclerotic epicardial coronary artery stenosis,[4,5] small intramural coronary artery dysplasia,[6] increased metabolic demands of the hypertrophied myocardium,[4] and less commonly, bridging of the epicardial coronary arteries.[7] The reported prevalence of significant epicardial coronary artery stenosis has varied, with large studies reporting rates as high as 26%.[8] The identification of epicardial coronary artery stenosis in patients with HCM is important as it is associated with poor prognosis.[8] Although noninvasive stress testing can be used in the initial assessment of HCM patients with chest pain, false-positive tests are common,[9–11] often necessitating the need for coronary anatomic assessment. Currently, American College of Cardiology Foundation/American Heart Association guidelines provide a class I recommendation for use of invasive coronary angiography in patients with HCM and chest pain.[12] Although generally a safe test, this procedure is associated with a small but definite risk of complications.[13]

Coronary CT angiography (CCTA) is an accurate noninvasive test which has become the test of choice to rule out significant epicardial coronary artery stenosis in low-to-intermediate risk patients.[14] With a high negative predictive value,[15] it may be the test of choice in the HCM patient with anginal symptoms to rule out significant epicardial coronary artery stenosis. However, the utility of CCTA in this population has not been previously described.

The aims of our study were to[1] describe the use of CCTA for the assessment of epicardial coronary artery stenosis in patients with HCM and stable angina symptoms,[2] compare the prevalence of epicardial coronary artery stenosis in patients with HCM and stable anginal symptoms to an age- and gender-matched control group with similar symptoms using CCTA, and[3] evaluate the accuracy of perfusion imaging to detect epicardial coronary artery stenosis in a subgroup of patients with HCM.

2. Methods

2.1. Patients

We retrospectively identified all adult patients with a confirmed diagnosis of HCM (based on cardiologic review of clinical, imaging, and electrocardiography [ECG] findings) who were referred for a CCTA at our institution over a 3-year period with symptoms of stable angina or angina equivalent (shortness of breath). In addition, a separate group of age- and gender-matched adult patients without HCM or known prior coronary artery stenosis referred for CCTA for similar symptoms over a 6-month period were identified as the control group. There were no exclusion criteria. Chart review was performed for all HCM and control patients. Anginal symptoms as well as risk factors for coronary artery atherosclerosis were recorded. The study was approved by the institutional research ethics board, and individual consent was waived.

2.2. Coronary CT angiography

CCTA studies were performed on an Aquilion ONE 320 scanner (Toshiba Medical Systems, Japan). Axial unenhanced prospectively gated images were acquired at 3.0-mm slice thickness for calcium scoring, followed by an axial contrast-enhanced study at 0.5-mm slice thickness using prospective ECG gating (70%–80% of R-R interval if the heart rate <60 beats/min and 40%–80% R-R for heart rates >60 beats/min). Oral metoprolol (75 mg for patients weighing <70 kg or 150 mg for patients weighing >70 kg) was given preprocedure to reduce the heart rate. Additional intravenous metoprolol 5 to 40 mg was given in the CT suite when required to achieve the target heart rate (<60 beats/min). Low-dose sublingual nitroglycerin (0.3 mg) was given to all patients with caution in HCM patients as nitroglycerin can theoretically increase dynamic left ventricular outflow obstruction.[16]

Image postprocessing was done on a dedicated Vitrea Workstation (Vital Images, Minneapolis, MN). The coronary arteries were evaluated on the axial images, multiplanar reconstruction, curved multiplanar reconstruction, maximum intensity projection, and 3-dimensional (3D) volume-rendered images. Caliper vessel diameter measurements of any abnormal segment were compared with those of a proximal normal segment to generate a measure of percent diameter stenosis. The presence of myocardial bridging, its depth (epicardium to vessel border), and length of any bridged segment was documented.

All cases were reviewed independently by 2 experienced observers blinded to any clinical information. Disagreements were arbitrated by a third reader. We used the quantification scheme common in our institution, modified from existing Society of Cardiovascular Computed Tomography guidelines. Any luminal narrowing >70% was labeled “severe” coronary artery stenosis. Any narrowing <50% was considered mild and between 50% and 70% was interpreted as moderate.

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