

# Complementary utility of multislice computed tomographic coronary angiography for detection of high-grade lesions in patients with negative stress myocardial perfusion imaging

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Myocardial perfusion imaging (MPI) is a highly sensitive and specific test for noninvasive detection of coronary artery disease. Therefore, in patients with negative MPI results, further noninvasive testing is usually not pursued. We report a series of patients with negative MPI results in whom 64-slice computed tomographic coronary angiography accurately predicted flow-limiting coronary lesions requiring subsequent revascularization.

Myocardial perfusion imaging (MPI) is a highly sensitive and specific test for the diagnosis of coronary artery disease (CAD), with reported sensitivity of 87% to 89% and specificity of 73% to 75% (1). In patients with symptoms suggestive of angina, MPI is often done as the primary diagnostic test. Although a negative MPI result usually portends a very good prognosis (2), it does not rule out CAD, especially in patients who have a moderate pretest probability of CAD. As a result, in patients with persistent symptoms of chest pain, a moderate risk of CAD, and a negative MPI result, further testing may still be performed to convincingly rule out obstructive coronary stenoses.

Computed tomographic coronary angiography (CTCA) is a rapidly evolving noninvasive modality for doing coronary angiography that has been shown to have acceptable sensitivity and specificity (3). However, its utility in predicting CAD in patients with normal MPI scans is unknown. We report a series of patients in whom 64-slice CTCA was performed after a negative or low-probability MPI result due to continued clinical suspicion. In each of these cases, significant flow-limiting disease was suggested by the CTCA and then subsequently confirmed by invasive coronary angiography.

## METHODS

A series of “moderate”-risk patients underwent a dual-isotope myocardial perfusion study in the clinical setting of chest pain. A weight-adjusted dose of thallium (on average 3 mCi) was injected in the resting condition. Subsequently, during adenosine infusion or following peak treadmill exercise, the patients were injected with a second dose of

approximately 24 mCi of  $^{99m}\text{Tc}$ -MIBI, and a gated acquisition was performed. Corresponding tomographic slices in the stress and resting phases were directly compared using a visual qualitative inspection to assess for perfusion. Wall motion, thickening, and an estimated left ventricular ejection fraction were generated from a separate review of the gated data. All the perfusion images were read by experienced readers.

Due to continued clinical suspicion and ongoing symptoms of angina, these patients underwent 64-slice CTCA (LightSpeed VCT, GE Healthcare) to further define coronary anatomy. Patients' heart rates were lowered using pre-CT beta-blockade where applicable, with additional intravenous beta-blockers given at the time of the scan. Sublingual nitroglycerine was given prior to the scan as a part of the routine protocol. CTCAs were interpreted by a reader with level 3-equivalent experience in CTCA (4).

In each of these cases, the results from the CT suggested “high-grade” lesions in one or more arteries. Invasive angiography was performed, and the results of the CTCA were then compared with those obtained from conventional angiography.

## RESULTS

CTCA demonstrated single-vessel CAD involving the left anterior descending artery in two patients. Two-vessel disease involving the left anterior descending and right coronary arteries was detected on CTCA in two patients. Three-vessel CAD was found in the remaining three patients (*Table*). In all patients, there was excellent anatomic correlation with invasive angiography (*Figures 1 and 2*).

Based on angiography results, patients with either single or two-vessel disease underwent percutaneous coronary intervention with drug-eluting stent implantation. All three patients with triple-vessel disease underwent coronary artery bypass surgery.

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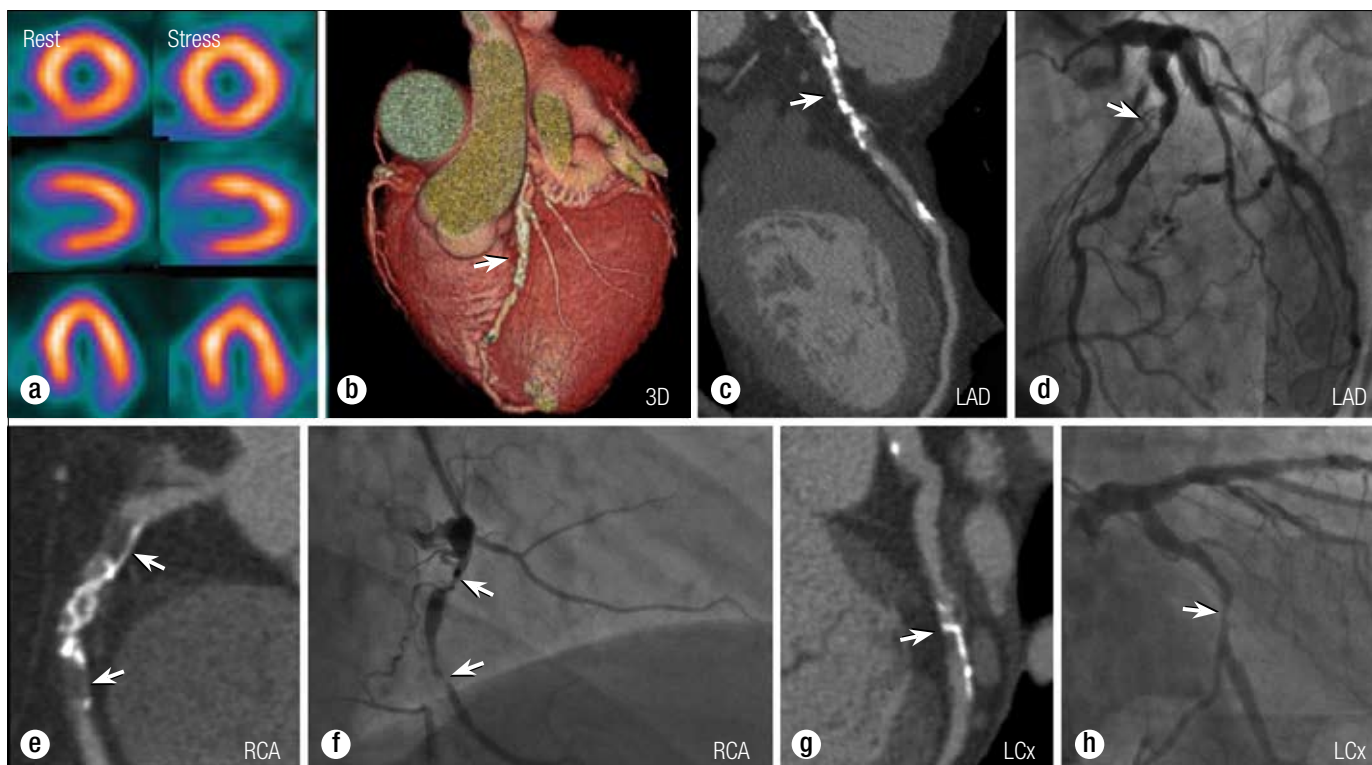
**Table. Comparison of MPI, CTCA, and conventional angiography findings in seven patients**

Patient	Exercise time (min)	ECG ischemia	MPI perfusion	CTCA: $\geq 50\%$ stenosis				Conventional angiography (% DR)			
				LM	LAD	OM	R	LM	LAD	OM	R
1	10:30	0	Normal	0	+	0	+	-	95	-	70
2	9:30	0	Normal	+	+	0	+	60	80	-	60
3	5:45	0	Normal	0	+	0	+	-	95	-	60
4	8:15	1 mm ST $\downarrow$	Normal	0	+	0	0	-	80	-	-
5	Adenosine	0	Inferior attenuation	0	+	+	+	-	70	95	99
6	Adenosine	0	Normal	0	+	0	0	-	95	-	-
7	9:50	1 mm ST $\downarrow$	Normal	0	+	+	+	-	80	70	99

MPI indicates myocardial perfusion imaging; CTCA, computed tomographic coronary angiography; ECG, electrocardiographic; DR, diameter reduction; LM, left main artery; LAD, left anterior descending artery; OM, obtuse marginal; R, right coronary artery.



**Figure 1.** Patient 6. (a) Myocardial perfusion imaging, (b) CT coronary angiogram, and (c) conventional angiogram for a patient with a high-grade lesion in the proximal left anterior descending artery.



**Figure 2.** Patient 7. (a) Myocardial perfusion imaging, along with (b, c, e, g) CT coronary angiograms and (d, f, h) invasive coronary angiograms demonstrating high-grade lesions in all coronary distributions (arrows).

## DISCUSSION

A “normal” MPI defines a population with a low probability of future cardiac events (2). However, there are well-described false-negative MPI scans (5). This may be due to “balanced disease” or lack of a flow-limiting lesion under testing conditions. As a result, in some patients with a negative MPI scan, further testing to rule out CAD may be warranted. This is especially true in the setting of continued symptoms.

Multislice CTCA has recently emerged as a noninvasive modality for detection of CAD, with high sensitivity and specificity reported in the literature (3). Like invasive angiography, multislice CTCA can accurately reveal distribution of atherosclerotic plaques in the coronary bed and the degree of flow limitation. As a result, multislice CTCA can potentially help identify patients who have near-normal MPI scans due to balanced multivessel disease.

In this case series, CTCA was able to accurately diagnose single-vessel and multivessel disease despite normal MPI scans in a population with a moderate pretest probability of CAD. Nuclear perfusion scan is often the first test performed in the evaluation of a cardiac patient with moderate pretest probability of CAD. In some of these patients with normal or “near-normal” nuclear scans, further testing is warranted due to ongoing unexplained symptoms or continued concern for the patient’s well-being. In these circumstances, CTCA may be a complementary noninvasive testing modality for the further evaluation of patients with negative MPI scans.

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