Spiral computed tomography (CT) coronary angiography has emerged as a safe, noninvasive, patient-friendly diagnostic modality to detect the presence of coronary atherosclerosis. The diagnostic potential of cardiac spiral CT is large because it allows not only the detection of significant coronary stenoses but also the presence of nonobstructive calcific and noncalcific (lipid or fibrous) plaques. Eventually, after scaling up with advanced technology, it might replace invasive diagnostic coronary angiography. Computed tomography coronary imaging can detect early subclinical coronary artery disease, which might impact on prevention and treatment of high-risk individuals or might be helpful to assess progression of coronary artery disease or monitor the effectiveness of lifestyle changes or pharmacological treatment of coronary atherosclerosis. The coronary calcium score has been shown to carry predictive value over and above traditional risk factors, and CT assessment of the total coronary plaque burden (combination of extent and severity of obstructive and nonobstructive plaques) might provide more powerful prediction.

Much of this potential still has to be confirmed by well-designed clinical studies. The majority of reports regarding cardiac spiral CT have focused on the detection of hemodynamic significant stenoses in symptomatic patients with a high prevalence of coronary artery disease who were referred for invasive coronary angiography [1–6]. These studies demonstrated that a negative CT scan reliably excluded the presence of a significant coronary stenosis. A CT scan with a high negative predictive value might be particularly useful in patient populations with a low pretest risk of disease, such as those patients presenting with acute chest pain at an emergency department (ED) who have nondiagnostic electrocardiographic (ECG) changes and normal cardiac biomarkers.

The article by Goldstein et al. [7] in this issue of the Journal evaluated a diagnostic strategy with CT coronary imaging versus a strategy with nuclear stress testing in patients presenting with acute chest pain to the ED who were assessed to be at low risk. Risk was defined according to electrocardiographic findings (Q waves or ST-segment deviations or T-wave changes suggesting acute ischemia) and the presence or absence of 3 predictors in the ED: systolic blood pressure <100 mm Hg, rales heard above both lung bases, and known unstable heart disease. Low-risk patients had no ECG changes and presence of maximally 1 predictor [8]. In addition these patients had no elevated cardiac biomarkers and no contra-indication for CT, such as irregular heart rhythm, intolerance to iodinated contrast or beta-blocking drugs, or renal dysfunction.

Ninety-nine patients were randomized to a strategy with CT coronary imaging (a non–contrast-enhanced CT to assess the calcium score and an enhanced CT scan to assess extent and severity of coronary stenoses) and 98 patients were randomized to a strategy with nuclear stress testing. Multislice computed tomography (MSCT) patients with a calcium score <100 Agatston U or absence of stenosis >25% were discharged (68% of patients). Patients with a stenosis ≥70% were referred for invasive coronary angiography. This cleverly designed study protocol dealt with intermediate lesions (stenosis 26% to 70% or a calcium score >100) and non-assessable CT scans, owing to severe calcifications or poor image quality, by evaluating further with nuclear stress testing. Patients with a normal nuclear test were discharged, and those with an abnormal test underwent invasive coronary angiography. This combination of MSCT followed by a functional test in this group seems to have been effective with only 3 of 24 patients who required additional nuclear stress testing and were referred for invasive coronary angiography, of which 1 was positive for significant coronary artery disease. The patients that were randomized to primary nuclear stress testing who had a normal test were immediately discharged (95% of patients), and those with an abnormal test underwent invasive coronary angiography. The safety, diagnostic efficiency, and costs of both diagnostic strategies were evaluated. Not unexpectedly, the safety, in terms of absence of major cardiac complications, was not different in this low-risk group: no major cardiac adverse events were reported in either group during 6 months of follow-up. Although it is commendable to pay heed to safety aspects, it would require a very large number of patients to demonstrate a statistically significant difference between the 2 diagnostic strategies. The diagnostic efficiency, defined as the clinical ability of the primary testing strategy to correctly and definitely (no need for late cardiac testing) establish or exclude the presence of a significant coronary stenosis as the cause of...
acute chest pain during the index ED admission, was similar for both diagnostic strategies: 95% for MSCT, and 91% for nuclear testing. In-hospital diagnostic invasive coronary angiography was (according to the study protocol) performed almost twice as often in the MSCT strategy (11%) versus the nuclear test strategy (5%). This might reflect the fact that an MSCT-detected significant coronary stenosis triggers an oculo-stenotic reflex to refer these patients to invasive coronary angiography to deny or confirm the presence of a stenosis that might easily result in unduly high referral to unnecessary coronary angiography. The design of this study was appreciative of this potential problem, and patients with an MSCT-detected intermediate stenosis (25% to 70%) were referred to nuclear stress testing and only when these were flow-limiting was invasive coronary angiography performed. Obviously, visual assessment of the severity of a stenosis with a cutoff value of 70% creates a grey zone of uncertainty (more or less 70% stenosis) that might be reduced by quantitative MSCT coronary angiography. However, current CT technology is (still) too crude to allow the refined automated contour-detection algorithms to assess the stenosis severity, as is possible with quantitative coronary angiography. It is certainly prudent to assess patients with a CT-detected intermediate lesion with a functional test (nuclear or dobutamine echo stress testing) to reduce the number of unnecessary invasive coronary angiograms.

Of interest was the fact that an initial approach with MSCT was associated with a reduction in diagnostic time and costs comparable to standard diagnostic strategy, which is important, given the high expenditure of health care associated with the triage of patients with acute chest pain.

Two further problems need to be addressed with a primary CT strategy: radiation exposure, and the occurrence of serious incidental noncardiac findings. Multislice computed tomography as well as nuclear stress testing are associated with radiation exposure. The effective dose for nonpulsing 64-slice CT is estimated as 9.6 to 21.4 milliSieverts (mSv) and for ECG pulsing 64-slice CT is estimated as 9.6 to 21.4 milliSieverts. The effective dose for both diagnostic strategies: 95% for MSCT, and 91% for nuclear stress testing), to which one-third radiation exposure is added in 10% of the patients referred for invasive coronary angiography. If MSCT does not give a definitive diagnosis, alternative diagnostic strategies that avoid radiation exposure such as exercise ECG, dobutamine stress echo, or magnetic resonance stress testing should be investigated.

Assessment of acute chest pain in the ED remains a significant challenge, and the presence of potentially fatal conditions including acute coronary occlusion, aortic dissections, and pulmonary emboli (triple rule-out) should be assessed. This would require a CT scan protocol with a large field of view allowing global evaluation of thoracic structures, but that would compromise the evaluation of the coronary arteries and might lead to misinterpretation of coronary lesions.

Goldstein et al. (7) circumvented this problem by employing the risk algorithm of Goldman et al. (8), which rules out life-threatening disease and allows the use of a dedicated coronary scan protocol. However, a coronary scan protocol is not entirely limited to the heart but also visualizes the adjacent thoracic structures.

The frequency of incidental noncardiac findings, not mentioned in the article by Goldstein et al. (7), is not negligible and might raise concerns about the reviewing of the CT scans. Incidental findings required further diagnostic follow-up in 7.8% to 11% of patients during electron-beam tomography (EBT) calcium scoring, and 1.2% required specific treatment (10,11).

Onuma et al. (12), in patients with a high prevalence of coronary artery disease undergoing MSCT, identified 22.7% new significant noncardiac findings requiring clinical or radiological follow-up, of which 0.8% were malignancies. More notably, of 201 patients who had no cardiac abnormalities detected, 16% (32 of 201) were diagnosed with noncardiac findings that could explain the cause of symptoms.

A comprehensive evaluation of thoracic structures for noncardiac disease such as pneumonia, pleural calcification, and hiatal hernia might add to the usefulness of MSCT as a diagnostic tool when compared with other modalities such as nuclear and dobutamine stress testing.

Thus, a complete review of the heart and adjacent structures as obtained by cardiac CT should be performed in all clinical settings and ensure the best outcome for patients. This should be done by physicians trained in reviewing the heart and the adjacent structures, which is best guaranteed by teamwork: cardiologists and radiologists trained in both cardiologic and thoracic imaging.

Yet the protocol used in this study was designed to exclude important coronary artery disease rather than give a definitive diagnosis, and no clinical follow-up is presented of patients whose symptoms could not be explained by the CT findings. However, the approach of Goldstein et al. (7) was pragmatic and safe.

The study by Goldstein et al. (7) is important and hopefully the first of a large number of well-designed studies to evaluate the clinical role of MSCT with respect to other noninvasive tests in a wide variety of clinical settings.

Should MSCT be used as a screening tool for patients presenting to the ED with chest pain? We agree with the author’s sensible conclusion. We need further scientific evidence to be able to provide guidelines for the clinical use of spiral CT coronary imaging.

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