Computed Tomography (CT) to Detect Coronary Artery Calcification

See also: Contrast-Enhanced CTA for Coronary Artery Evaluation  
CTA and MRA of the Chest (excluding the heart)  
CTA and MRA of the Head, Neck, Abdomen, Pelvis, and Extremities  
Cardiac Computed Tomography

**Professional**
Original Effective Date: April 2002  
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September 20, 2011; November 6, 2012  
Current Effective Date: November 14, 2008

**Institutional**
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September 18, 2009; January 1, 2010;  
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**DESCRIPTION**
Electron beam computed tomography (CT; also known as ultrafast CT) uses an electron gun rather than a standard x-ray tube to generate x-rays, thus permitting very rapid scanning. Spiral CT scanning (also referred to as helical CT scanning) also creates images at greater speeds by rotating a standard x-ray tube around the patient such that data are gathered in a continuous spiral or helix rather than in individual slices. While both electron beam CT (EBCT) and spiral CT scanning may be valued as an alternative to
conventional CT scanning due to their faster throughput, their speed of image acquisition also permits unique imaging of the moving heart. For example, the rapid image acquisition time virtually eliminates motion artifact related to cardiac contraction, permitting visualization of the calcium in the epicardial coronary arteries. EBCT software permits quantification of calcium area and density, which are translated into calcium scores. Calcium scores have been investigated as a technique for detecting coronary artery calcification, both as a diagnostic technique in symptomatic patients to rule out an atherosclerotic etiology of symptoms or, in asymptomatic patients, as an adjunctive method for risk stratification for coronary artery disease.

As of 2007, EBCT and multi-detector computed tomography (MDCT) are the primary fast CT methods for measurement of coronary artery calcification. A fast CT study for coronary artery calcium measurement generally takes 10 to 15 minutes and requires only a few seconds of scanning time.

**POLICY**
The use of computed tomography (CT) to detect coronary artery calcification is considered experimental / investigational.

**RATIONALE**
The most recent update covers literature review from June 2011 through June 2012.

The rationale for measuring calcium in coronary arteries is that it measures coronary atherosclerosis. Coronary calcium is present in coronary atherosclerosis, but the atherosclerosis detected may or may not be causing ischemia or symptoms. Such a measure may be correlated with the presence of critical coronary stenoses or serve as a measure of the patient’s proclivity toward atherosclerosis and future coronary disease. Thus, it could serve as a variable to be used in a risk assessment calculation for the purposes of determining appropriate preventive treatment in asymptomatic patients. Alternatively, in other clinical scenarios, it might help determine whether there is atherosclerotic etiology or component to the presenting clinical problem in symptomatic patients, thus helping to direct further workup for the clinical problem. In this second scenario, a calcium score of zero usually indicates that the patient’s clinical problem is unlikely to be due to atherosclerosis and that other etiologies should be more strongly considered. In neither case does the test actually determine a specific diagnosis. Most clinical studies have examined the use of coronary calcium for its potential use in estimating the risk of future coronary heart disease events.

Coronary calcium levels can be expressed in many ways. The most common method is the Agatston score, which is a weighted summed total of calcified coronary artery area observed on computed tomography (CT). This value can be expressed as an absolute number, commonly ranging from 0 to 400. These values can be translated into age and sex-specific percentile values. Different imaging methods and protocols will produce different values based on the specific algorithm used to create the score, but the correlation between any 2 methods appears to be high, and scores from one method can be translated into scores from a different method. This policy is based, in part on a 1998 TEC Assessment. (1)
Coronary calcium for coronary disease risk stratification

Many prospective studies have shown evidence for predictive capacity of calcium scores in addition to assessment of traditional risk factors. In a study of 1,029 asymptomatic adults with at least 1 coronary risk factor, Greenland et al. (2) showed that a calcium score of greater than 300 predicted increased risk of cardiac events within Framingham risk categories. A study by Arad et al. (3) showed similar findings in a population-based sample of 1,293 subjects who had both traditional risk factors and calcium scores evaluated at baseline. A study by Taylor et al. (4) studied the association of the Framingham risk score and calcium scores in a young military population (mean age 43 years). Although only 9 acute coronary events occurred, calcium scores were associated with risk of events while controlling for the risk score. LaMonte et al. (5) also analyzed the association of calcium scores and coronary heart disease (CHD) events in 10,746 adults. In this study, coronary risk factors were self-reported. During a mean follow-up of 3.5 years, 81 CHD events occurred. Similar to the other studies, the relationship between calcium scores and CHD events remained after adjustment for other risk factors. Other studies (6-8) show similar findings. Additional studies have defined how the incorporation of calcium scores into risk scores changes risk prediction. In a study by Polonsky et al., (9) incorporation of calcium score into a risk model resulted in more subjects (77% vs. 66%) being classified in either high-risk or low-risk categories. The subjects who were reclassified to high risk had similar risk of CHD events as those who were originally classified as high risk. A study by Elias-Smale et al. (10) showed similar findings; reclassification of subjects occurred most substantially in the intermediate risk group (5-10% 5-year risk) where 56% of persons were reclassified.

A growing body of literature now addresses the relationship of traditional risk factors, calcium scores, and risk of CHD. Current treatment guidelines for coronary disease prevention recommend specific treatment based on prediction of coronary disease risk. The cited studies enrolled different populations, assessed different traditional risk factors, and assessed different coronary disease outcomes. Different calcium score cutoffs were analyzed in the studies. Given the variation in the studies, the magnitude of increased risk conferred by a given calcium score is still uncertain. The results of the study by Greenland et al. (2) would suggest that a high calcium score, as defined as a score greater than 300, does not change risk appreciably for those with Framingham risk scores less than 10% or greater than 20%. Given that there is no direct evidence that risk stratification using calcium scores in addition to traditional risk assessment improves patient outcomes, a consensus approach that integrates existing evidence with a modeling approach to predicting patient outcomes would aid in determining whether calcium scoring is of value.

Coronary calcium for ruling out atherosclerotic etiology of disease in symptomatic patients

In certain clinical situations such as patients presenting with chest pain or other symptoms, it is uncertain whether the symptoms are potentially due to CHD. Coronary calcium measurement has been proposed as a method that can rule out CHD in certain patients if the coronary calcium value is zero. Since coronary disease can only very rarely occur in the absence of coronary calcium, the presence of any coronary calcium can be a sensitive but not specific test for coronary disease. False positives occur because the calcium may not be causing ischemia or symptoms. The absence of any coronary calcium can be a specific test for the absence of coronary disease and direct the diagnostic workup toward other causes of the patient’s symptoms. In this context, coronary calcium measurement is not used to make a positive diagnosis of any kind but as a diagnostic “filter” used to rule out an atherosclerotic cause for the patient’s symptoms.
For example, in a study by Laudon et al. in the emergency department setting, 51% (133/263) patients with chest pain and low-to-moderate probability of CAD had calcium scores of zero. (11) One of these patients was found to actually have coronary disease. The others were presumed to not have coronary disease, and it is claimed that these patients could have been safely discharged from the emergency department. However, the study is not rigorous in its methods regarding the alternative workup of potential coronary artery disease in the emergency department or in the long-term follow-up of patients.

Evidence regarding the use of coronary calcium scores in the assessment of symptomatic patients has been reviewed in a 2007 clinical consensus co-written by the American College of Cardiology Foundation (ACCF) and the American Hospital Association (AHA). (12) Calcium scores have similar sensitivity and specificity to other tests such as exercise single-photon emission computed tomography (SPECT) and stress echocardiography for the diagnosis of anatomic obstructive CHD. It is difficult to determine the validity of these diagnostic performance characteristics given the possible referral and confirmation biases. If the performance of the reference standard for coronary disease such as angiography is based upon the results of the diagnostic tests under study, diagnostic test characteristics are biased.

**Impact on cardiac risk factor profiles**

There have been 2 randomized, controlled trials (RCTs) of the impact of electron-beam computed tomography (EBCT) on cardiac risk factors. O’Malley et al. (13) randomized 450 subjects to receive EBCT or not and assessed outcomes 1 year later for change in Framingham Risk Score. Thus, EBCT was to be used as a guide to refine risk in patients and possibly provide motivation for behavioral change. The study was not powered for clinical endpoints. EBCT did not produce any benefits in terms of a difference in Framingham risk score at 1 year.

An RCT was published in 2011 evaluating the impact of computed tomography (CT) scanning for coronary artery calcium on cardiac risk factors. (14) A total of 2,137 healthy individuals were randomized to CT scanning or no CT scanning and followed for 4 years. At baseline, both groups received 1 session of risk factor counseling by a nurse practitioner. The primary outcome was change in 12 different cardiac risk profile measures, including blood pressure (BP), lipid and glucose levels, weight, exercise, and the Framingham risk score. At the 4-year follow-up, there was differential dropout among the groups, with 88.2% of follow-up in the scan group versus 81.9% in the no-scan group. Results demonstrated differences in 4 of the 12 risk factor measurements between groups: systolic BP, low-density lipoprotein (LDL), waist circumference, and mean Framingham risk score.

This trial highlights the potential benefit of coronary artery calcium screening in modifying cardiac risk profile but is not definitive in demonstrating improved outcomes. Limitations of this study include different intensity of interventions between groups and differential dropout. It is possible that the small differences reported in the trial were the result of bias from these methodologic limitations. In addition, this trial does not compare the impact of other types of risk factor intervention, most notably more intensive risk factor counseling. Finally, the generalizability of the findings is uncertain given that this was a volunteer population that may have been highly motivated for change.
Future research needs
The current research mainly establishes that coronary artery calcium screening improves risk prediction for coronary artery disease. The 2011 randomized controlled trial (RCT) suggests that scanning may favorably impact cardiac risk profiles but is not sufficient in itself to demonstrate improved outcomes. In order to demonstrate that use of calcium scores improves the efficiency or accuracy of the diagnostic workup of symptomatic patients, rigorous studies that define exactly how coronary calcium scores are used in combination with other tests in the triage of patients would be necessary. Study designs need to explicitly evaluate diagnostic strategies that compare one strategy which uses calcium scores to an alternative which does not use calcium scores. Ideally, patient outcomes and resource utilization would need to be prospectively evaluated.

Clinical Input Received through Physician Specialty Societies and Academic Medical Centers
In response to requests, input was received through 2 physician specialty societies and 4 academic medical centers on this policy (the version approved in July 2008) in November 2008. While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted. The majority of those providing input agreed with the conclusions of this policy (investigational) as approved in July 2008.

Clinical input received in 2011 was mixed regarding the investigational status of coronary artery calcium screening. Input was received from 7 sources, 5 academic medical centers, and 2 specialty societies. Four of the 7 reviewers agreed with the investigational status, while 3 dissented. The dissenters primarily cited evidence on the accuracy of scanning for risk prediction of CAD. The American College of Cardiology also cited the 2011 RCT as evidence of the impact of scanning on risk factor profile.

Summary
There is extensive evidence on the predictive value of coronary artery calcium screening for cardiovascular disease, and this evidence demonstrates that scanning has incremental predictive accuracy above traditional risk factor measurement. High-quality evidence is lacking comparing the use of coronary artery calcium screening to other methods of enhanced risk prediction, and as a result, there is uncertainty as to which methods are preferred in specific populations. Limited evidence from clinical trials suggests that scanning may lead to improved risk factor profiles, but this finding has not been consistent and methodologic limitations preclude definitive conclusions on this question.

Evidence-based guideline statements regarding calcium score measurement give, at best, a reserved recommendation in favor of the use of EBCT and recognize the incomplete evidence base that supports those recommendations. Review of several guidelines shows disagreement regarding the utility of calcium score measurement. The USPSTF review highlights the inconsistency of the relative risk of coronary disease associated with calcium scores, thus making risk estimates based on it imprecise. Because of the lack of high-quality evidence demonstrating improved outcomes and the lack of strong recommendations from authoritative sources, the use of computed tomography (CT) to detect coronary artery calcification is considered investigational.
Practice Guidelines and Position Statements

In 2006, the American Heart Association (AHA) issued a scientific statement (15) on the use of cardiac CT. Most of the document reviewed the utility of calcium scoring for the use of determining prognosis and diagnosis. In addition to reviewing a large body of evidence regarding calcium scoring, clinical recommendations were also offered. No indications received a class I recommendation, i.e., evidence and/or agreement that the procedure is useful and effective. Several indications received a class IIb recommendation, which means that there is conflicting evidence and/or a divergence of opinion regarding usefulness or efficacy. The “b” qualifier indicates usefulness/efficacy is less well established. The indications that received an IIb recommendation were:

- Patients with chest pain with equivocal or normal ECGs [electrocardiograms] and negative cardiac enzymes
- Determining the etiology of cardiomyopathy
- Symptomatic patients, in the setting of equivocal treadmill or functional tests
- Asymptomatic patients with intermediate (e.g., 10-20% 10-year risk) risk of CAD [coronary artery disease]

Four indications received a class III recommendation, which means that there is evidence that the procedure or treatment is not useful or possibly harmful. These indications were:

- Low-risk (<10% 10-year risk) and high-risk (>20% 10-year risk) asymptomatic patients
- Establishing the presence of obstructive disease for revascularization in asymptomatic persons
- Serial imaging for assessment of progression of coronary calcification
- Hybrid nuclear and CT imaging

The 2006 AHA scientific statement (15) also cited several other studies showing an association between calcium scores and CAD events after adjustment for traditional risk factors. The report recognized that despite growing evidence that calcium scores are an independent predictor of CAD, studies have not demonstrated improved clinical outcomes as a result of calcium score screening. This scientific statement reflected these uncertainties in the utility of calcium scoring in their clinical guideline statements.

A 2007 clinical consensus document co-written by the American College of Cardiology Foundation (ACCF) and the AHA (12) reviewed much of the same evidence as the 2006 AHA scientific statement. It should be noted that this type of consensus document represents the best attempt of the ACCF and AHA to inform clinical practice where rigorous evidence is not yet available. Thus formal grading of evidence and classification of clinical recommendations are not reported in this type of document. This document essentially concludes that the indications receiving an IIb recommendation in the 2006 scientific statement “may be reasonable…. Recommendations from the 2010 ACCF/AHA Guidelines are noted below.

In 2009, the U.S. Preventive Services Task Force (USPSTF) issued recommendations regarding the use of nontraditional or novel risk factors in assessing CHD risk in asymptomatic persons. (16,17) Calcium score was 1 of 9 risk factors considered in the report. They concluded that the current evidence is insufficient to assess the balance of benefits and harms of using any of the nontraditional risk factors studied to assess risk of coronary disease in asymptomatic persons. In their focused review of 5 studies, which they judged to have valid study designs, they found wide variation in the estimates of the risk ratio for higher calcium scores. Higher quality studies had lower relative risks for a given difference in calcium score. This review disagrees with the
ACCF/AHA 2007 clinical consensus document (12) regarding the effect of calcium scores on reclassifying risk of coronary disease. Rather than the 4 studies that the ACCF/AHA document claims provides information about reclassification, the USPSTF report only finds one such study.

Recommendations on calcium scoring from the 2010 ACCF/AHA Guidelines (18) are as follows:

**Class IIa**
Measurement of CAC [coronary artery calcification] is reasonable for cardiovascular risk assessment in asymptomatic adults at intermediate risk (10% to 20% 10-year risk). (Level of Evidence: B)

**Class IIb**
Measurement of CAC may be reasonable for cardiovascular risk assessment in persons at low to intermediate risk (6% to 10% 10-year risk). (Level of Evidence: B)

**Class III: No Benefit**
Persons at low risk (<6% 10-year risk) should not undergo CAC measurement for cardiovascular risk assessment. (Level of Evidence: B)

A systematic review by Ferket et al. (19) identified 14 guidelines that evaluated diagnostic imaging for asymptomatic coronary artery disease, which included those reviewed above, and additional guidelines from New Zealand and Canada. Ten of the guidelines addressed use of calcium score as a method to improve coronary risk assessment. Four guidelines concluded that there was sufficient evidence for consideration of its use, and 1 guideline recommended for its use. The only group of patients for whom its use was recommended was that of intermediate-risk patients. For subjects at low risk or high risk, guidelines were unanimous in not advocating calcium scoring.

**CODING**
The following codes for treatment and procedures applicable to this policy are included below for informational purposes. Inclusion or exclusion of a procedure, diagnosis or device code(s) does not constitute or imply member coverage or provider reimbursement. Please refer to the member’s contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

**CPT/HCPCS**

- 75571  Computed tomography, heart, without contrast material, with quantitative evaluation of coronary calcium.
- S8092  Electron beam computed tomography (also known as ultrafast CT, cine CT)

- Effective in 2010, there is a category I CPT code for this imaging, which is 75571.
- When quantitative assessment is performed as part of the same encounter as contrast-enhanced cardiac CT (codes 75572-75573) or coronary CT angiography (code 75574), it is included in the service.
- The primary fast CT methods for this determination are electron-beam computed tomography (EBCT) and multi-detector computed tomography (MDCT).
**DIAGNOSIS**
Experimental / Investigational for all diagnoses related to this policy.

**REVISIONS**

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<tr>
<th>Date</th>
<th>Changes</th>
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<tbody>
<tr>
<td>11-14-2008</td>
<td>- Changed title from Electron Beam Computerized Tomography (EBCT) Screening for Cardiovascular Calcium Deposits also known as Ultrafast CT, CT angiography and CINE CT to Computed Tomography to Detect Coronary Artery Calcification.</td>
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<tr>
<td></td>
<td>- Added a rationale section to the policy.</td>
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<tr>
<td></td>
<td>- In Coding section, added CPT codes: 0144T, 0147T, 0149T.</td>
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<tr>
<td>09-18-2009</td>
<td>In Header:</td>
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<td>- Added reference policies: Contrast-Enhanced CTA for Coronary Artery Evaluation, CTA and MRA of the Chest (excluding the heart), CTA and MRA of the Head, Neck, Abdomen, Pelvis, Lower Extremity, and Upper Extremity, and Cardiac Computed Tomography (CT).</td>
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<td>Updated Rationale and References sections</td>
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<tr>
<td>01-01-2010</td>
<td>In Coding Section:</td>
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<td>- Added CPT Code: 75571</td>
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<td>- Removed CPT Codes: 0144T, 0147T, 0149T</td>
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<td>Description section updated.</td>
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<td>Rationale section added.</td>
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<td>11-06-2012</td>
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<td>In Coding Section:</td>
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<td>Added a Diagnosis section and the following wording, &quot;Experimental/Investigational for all diagnoses related to this policy.&quot; As no reference to diagnosis was previously reflected in the policy.</td>
</tr>
<tr>
<td></td>
<td>References section updated.</td>
</tr>
</tbody>
</table>

**REFERENCES**

1. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). Diagnosis and screening for coronary artery disease with electron beam computed tomography TEC Assessments 1998; Volume 13, Tab 27.


