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The data provided in the article by Nieman et al., coupled with the prior and continuing data from EBT scanning, beg the question, “Is coronary CT arteriography (CTCA) ready to kick it up another notch?”

Before this question can be further addressed, we need to be sure of the current playing field, which is likely to continue to evolve in the coming years for both EBT and MSCT. Table 1 lists some important current issues related to these methods addressing “true” temporal resolution, spatial resolution, practical heart rate limitations for application, issues of functional/perfusion imaging in the same scanning session, and use of CAC for plaque quantitation in addition to luminal evaluation, radiation exposure, and availability.

The most glaring differences between EBT and MSCT are still considerable differences in temporal resolution, which then influence practical limits on resting heart rate in subjects under examination. EBT has superior temporal resolution, but at the present time, MSCT has superior spatial resolution. Nieman and colleagues administered metoprolol orally to nearly 60% of the test subjects before performing the study to induce relative bradycardia with resting heart rates at <60 beats/min. Such a practice of administering high dose β-blockers before or in conjunction with the study solely to lower the resting heart rate so that the study can be performed adequately may limit use of even the latest MSCT to hospital-based imaging centers or specialized outpatient centers with adequate support for monitoring of the patient before and after the procedure. Additionally, only a minority of patients studied by Nieman et al. could be examined using prospective ECG gating, and most required retrospective review of multiple-gated images to choose tomograms that displayed the least apparent coronary artery motion artifacts. Such a practice also significantly increases the radiation dose substantially above that for EBT. Using MSCT and retrospective ECG-gating, these values may approach that used for an intravenous pyelogram. Although these doses are reasonable for many radiographic procedures, it will require that the patient’s creatinine be known before the study.

Despite the cogent issues related to CT scanning architecture and developing EBT/MSCT methodology, in my opinion, CTCA is ready to advance to the next step and “kick it up another notch.”

It is clear that the sensitivity and specificity of CTCA, under appropriate circumstances and in the right patients, is equivalent and perhaps superior to the use of stress testing using nuclear or echocardiographic imaging. As with many techniques that define their validity by comparisons to select patients undergoing clinically indicated coronary arteriography, the issue of referral bias must be borne in mind. As these alternative methods are introduced into clinical practice, the sensitivity may be lessened because of the referral bias inherent in their validation, but the specificity is often significantly improved. Such has been the case when attempting to predict coronary stenoses using CAC by EBT.

The fundamental issue here is that there must be an understanding of how and where CTCA may fit into clinical practice and this must be the “next step” before prime time! In my opinion, the next step needs to be cautious but conservative application of these methods into selected clinical practice situations. Although there has been discussion for some time about how these methods should be performed and how they should be analyzed, we need to keep track of why they are being investigated in the first place.

Although the use of stress testing, particularly perfusion and functional imaging, often has clinical value over and above merely defining the physiological significance of coronary artery stenosis, the vast clinical goal for such methods is as a noninvasive alternative to invasive arteriography to affirm or deny the presence of coronary obstructive disease. If there were a way to “visualize” the stenosis in a noninvasive, straightforward, practical, and safe manner, then it would in many instances be considered a very strong alternative to stress testing or an adjunct to conventional diagnostic coronary arteriography in low to intermediate likelihood individuals. Along this line, I offer some “potential” applications for CTCA in Table 2. Of course, as with any potential list such as this, proven validity will require additional investigations and comparison with more traditional methods.

The advantages of CT are that one is able to define CAC, a surrogate to defining mural atherosclerotic plaque burden, as well as the extent to which larger epicardial vessels may be narrowed. Functional and perfusion imaging may also be considered at the same time (currently limited to EBT...

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### Table 1. Current “Characteristics” of EBT Versus MSCT

<table>
<thead>
<tr>
<th>Modality</th>
<th>True Temporal Resolution</th>
<th>Spatial Resolution</th>
<th>“Practical” Heart Rate Limitations for a Diagnostic Study</th>
<th>Cardiac Function and Myocardial Perfusion</th>
<th>Radiation Exposure, mSv</th>
<th>Clinical Availability</th>
<th>Coronary Calcium Quantitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBT</td>
<td>50–100 ms</td>
<td>1.5 mm vessels</td>
<td>50–100 beats/min</td>
<td>Yes</td>
<td>1–2</td>
<td>Increasing slowly</td>
<td>Yes, extensively validated</td>
</tr>
<tr>
<td>MSCT</td>
<td>230–1000 ms</td>
<td>1.0 mm vessels</td>
<td>&lt;60–65 beats/min</td>
<td>No</td>
<td>2–10</td>
<td>Expanding rapidly</td>
<td>Yes, limited validation</td>
</tr>
</tbody>
</table>

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Noninvasive Coronary Angiography Using CT
imaging). Cardiovascular medicine specialists will, by default, need to learn the “new language” of 3D imaging such as MIP (maximum intensity projection), MPR (multi-planar reformation), SSD (shaded surface display), and VRT (volume rendering technique), and learn to cope with simultaneous opacification of coronary veins along with the arteries. Even the most advanced angiographers may have to go “back to school” to get this training, and I and others have voiced opinions to advocate implementation of a mentoring system to accomplish these goals.13

The disadvantage of CTCA is that it is unlikely at any time in the foreseeable future to achieve the resolution of cine film and is likely thus limited to examination of epicardial arteries 1 to 2 mm in diameter or larger. Subtle details of small collateral vessels, small coronary branch arteries, and regions such as distal anastomotic sites of bypass grafts may be lost. Furthermore, moderate to extensive focal coronary calcium may obscure adequate visualization of the lumen, and it is also unlikely that CTCA will be able to resolve in-stent stenoses.

However, despite these issues, we have seen considerable improvements in CT cardiac imaging even over the past few years, and the future remains secure as we “kick it up another notch.”

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References


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