Replacing diagnostic catheterization with coronary CT angiography: the final frontier

U. Joseph Schoepf1,2*, Pal Suranyi1, Christian Thilo1,2, Philip Costello1, and Peter L. Zwerner1,2

1Department of Radiology, Medical University of South Carolina, Charleston, SC 29425, USA and 2Department of Medicine, Division of Cardiology, Medical University of South Carolina, Charleston, SC 29425, USA

Online publish-ahead-of-print 3 September 2007

This editorial refers to 'Diagnostic accuracy of dual-source multi-slice CT: coronary angiography in patients with an intermediate pretest likelihood for coronary artery disease' by A. Leber et al., on page 2354

Since the inception of coronary multi-detector-row computed tomography (MDCT) angiography a decade ago, authors of scholarly articles worldwide have hypothesized, theorized, and prophesied, that non-invasive coronary CT angiography (CTA) will largely replace invasive diagnostic coronary catheterization in the near future. Even in the early days, with limited technology, such as 4-slice or 16-slice CT, there was sound reason for this belief. Comparison of 4-slice coronary CTA with invasive coronary angiography yielded a spectacular negative predictive value of 97%.

In later years, even the most scrupulous comparative trials on 16-slice coronary CTA confirmed the almost perfect performance of this test for ruling out significant stenosis. While earlier studies commonly involved the impractical approach of excluding patients, vessels, or vessel segments that were not well visualized from the analysis, it has been demonstrated that more recent scanner generations can safely rule out significant stenosis without any exclusions. The overwhelming need for a non-invasive, economical test that can safely rule out significant coronary artery stenosis is unquestioned. Ad nauseaem, articles on coronary artery imaging invariably belabour the socio-economic importance of heart disease and the fact that the majority of cardiac catheterizations are performed for mere diagnostic purposes, without therapeutic consequences or intent. Coronary CTA is uniquely suited to address this need, if patient management is based on the high negative predictive value of this test. Patients are spared an invasive procedure, and the charges for coronary CTA are a fraction of the cost of a diagnostic catheter. Institutions that operate both a cardiac CT scanner and a catheterization lab can use coronary CTA as a first-line triage tool to identify patients with significant disease for catheter-based intervention and fill the catheterization lab schedule specifically with those, ordinarily with better yields in overall reimbursement.

So, why is diagnostic catheterization still clinging on? Generally, the field of Medicine is moving cautiously, and new tests, as beneficial as they may appear, are only slowly embraced. Although hardly anybody would disagree with the great potential of coronary CTA, the evidence base admittedly is still somewhat sketchy. In the case of coronary CTA, this is mainly explained by the rapid technical evolution, which occurs at a much faster pace than our ability to evaluate it scientifically. However, there are also specific, intrinsic reasons that may have been slowing down the ubiquitous embrace of coronary CTA. There have been concerns vis-à-vis radiation exposure and the technical and logistical challenges of the procedure, including pharmacological rate control. Many previous studies have been criticized for selection bias. Also, although the sensitivity of coronary CTAs for ruling out significant stenosis is unquestioned, (cost-) effectiveness of a test significantly hinges on specificity, which, in the case of coronary CTA, has been trailing behind sensitivity. This latter aspect, the sheer volume of potentially eligible patients, and only recently better defined appropriateness criteria have largely prevented health care carriers from providing reimbursement uniformly for this test, although, if appropriately used, cost-effectiveness is almost a given.

The study by Leber et al. is significant, as it effectively addresses a number of these concerns. First, it is a timely and topical assessment of the performance of dual-source CT, the most recent generation of MDCT scanners. The introduction of this technology has been shown to mitigate some of the concerns that have been prevailing with regards to radiation exposure at coronary CTA, although, if appropriately used in a patient who would otherwise require invasive catheterization, radiation exposure becomes a secondary concern. As convincingly demonstrated in this research, dual-source CT has largely relegated the need for pharmacological rate control to the past, which massively widens the scope of patients who are eligible to undergo this test. While previous investigations have been accused of selection bias, this current study focuses precisely on the patient population which is most likely to benefit from a test that can
serve as a non-invasive tie-breaker for guiding patient management: those with intermediate likelihood for coronary artery disease who would otherwise undergo invasive work-up. Lastly, improved specificity for lesion detection while maintaining perfect sensitivity will further bolster the usefulness, acceptance, and cost-effectiveness of this test.

So what remains to be done before coronary CTA will fully replace diagnostic catheterization in appropriate patient populations? The performance indices of current generation MDCT scanners for lesion detection are astounding; however, the literature on patient outcome and cost-effectiveness of this test is still scarce. Significant research is still required to define more precisely the appropriate place of coronary CTA in the diagnostic work-up of patients with suspected coronary artery disease. Maybe even more importantly, the health care systems need to be convinced of the benefits and effectiveness of this amazing, but nascent technology. It is upon us, as the clinicians who prescribe this test, to ensure that mistakes of the past are not repeated, that coronary CTA is not abused as the latest pathway for self-referral, that this test is not applied as a fancy screening commodity for the worried well, but as a powerful diagnostic tool for the right patient, at the right time.

Conflict of interest: U.J.S. is a medical consultant to Bayer, Bracco, General Electric, Medrad, Siemens, and TeraRecon, and receives research support from Bayer, Bracco, General Electric, Medrad, and Siemens. P.S. and C.T. are medical consultants to Bayer. P.L.Z. is a medical consultant to Bracco. P.C. is a medical consultant to Bracco and receives research support from Siemens.

References
3. Herzog C, Zwerner PL, Doll JR et al. Significant coronary artery stenosis: comparison on per-patient and per-vessel or per-segment basis at 64-section CT angiography. Radiology 2007;244:112–120.