

Computed Tomographic Angiography and the Atlantic

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Coronary computed tomographic angiography (CTA) has become possible based on a rapid succession of technical developments. Substantial improvements both in the spatial and temporal resolution of computed tomography (CT) were the prerequisites for visualizing the small and rapidly moving structures of the heart. Very early applications of cardiac CT imaging—using electron beam tomography (EBT) in the 1980s—were directed toward the evaluation of left ventricular function and perfusion. The detection and quantification of coronary calcium, as a means to identify patients at increased risk for a future myocardial infarction, became the major focus in the 1990s. While not undisputed, calcium screening received widespread attention. However, this was limited almost exclusively to the U.S. and was hardly used in other parts of the world.

The very first reports of coronary CTA for visualization of the coronary lumen and detection of stenoses after intravenous injection of contrast agent while still using the EBT scanner were published around 1995. This was not widely available and was fraught with somewhat limited spatial resolution and relatively high image noise. It was not until the year 2000, when 4-slice spiral (or *helical*) CT was introduced, that conventionally designed CT systems offered visualization of the coronary arteries. In the ensuing years, an unprecedented pace of technology has culminated in the development of the 256- and 320-slice systems as well as dual-source and -energy CT. Because of the widespread availability of spiral CT and the broad implications for clinical care, coro-

nary CTA is rapidly entering the clinical arena, which poses unique challenges in many ways. Some challenges are medical and scientific in nature, such as evaluating the test's accuracy during constantly evolving technology, identifying applications which will translate into a definite clinical benefit, and developing algorithms that will minimize the risks of contrast administration and radiation exposure. Other challenges are of a logistic nature. How can adequate training be provided and how can adequate quality of imaging and interpretation be ensured? Since this method requires expertise both in radiology and cardiology, who should perform this procedure? Finally, economic constraints and reimbursements have substantially influenced the practice of CTA.

During this evolution, there have been interesting differences in the way the practice of CTA has been adopted on either side of the Atlantic (Table 1). For instance, in contrast to coronary calcium research, a larger proportion of the scientific work related to CTA has been, and continues to be, performed in countries outside the U.S. (mainly in Europe and Japan). This might, in part, be an unintended consequence of a restrictive regulatory process in the U.S. On the other hand, it could also show dependence on third-party payors to allow a wider percolation of new technology in the U.S. In either case, it does not bode well if barriers restrict efficient development of promising new technology or require costly and time-consuming recreation of the same data in every regional regulatory locale. It is certainly appropriate to carefully monitor and, in certain ways, regulate the introduction of a new imaging test but with the least amount of burden and reduplication. Another important difference stems from the fact that the turf battles between speci-

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Table 1. Coronary CTA in the U.S., Europe, and South America

Country	Reimbursement for CTA	Separate Billing Code for CTA	Approximate Reimbursement	Restricted to Radiologists	Criteria for Competency
U.S.	Yes*	Coronary CTA	?	No	Yes
Germany	Not specifically	Chest CT	€400	Yes	No
Italy	Yes	Chest CT	€158	Yes	No
Finland	Yes	Coronary CTA	€486	No	No
the Netherlands	Yes	Variable	€200	Yes	No
Switzerland	Yes	Chest CT	€800	Not	No
Mexico	No	No code	US \$700-1,400	No	No
Brazil	Usually not	Chest CT	US \$~500	No	No

*Varies by insurance, pre-approval may be necessary; †only radiologists can bill for a computed tomographic (CT) scan.
CTA = computed tomographic angiography.

ality societies have not been highlighted as much in Europe. This could again be partly a result of lesser economic pressures and competition in the profession and partly due to a more formal regulatory demarcation of the scope of practice in Europe. It is heartening that societies in the U.S. are now jointly sponsoring strategies for future development of this modality. The ultimate goal still *must* be that none of these *should* hinder patients from receiving the new diagnostic test if it is of benefit. Further, the introduction of coronary CTA has led to a more aggressive creation of regulatory restrictions in the U.S. as compared to other countries. Whereas in many European countries CT imaging is legally restricted to radiologists, such as in Germany and Italy, and cardiologists can only perform and interpret coronary CTA examinations in conjunction with a radiologist, this is not the case in the U.S. On the other hand, no other country has as specific rules and recommendations concerning competency for performing coronary CTA, although the regulations in the U.S. are not binding and recommendations by the American College of Radiology (1) differ substantially from those jointly issued by the American College of Cardiology and American Heart Association (2). The Certification Board for Cardiac Computed Tomography (CBCCT) examination, first administered in September 2008, has been established based on a joint initiative by several professional societies. However, since cardiac CT imaging is not formally included in and not even available to most radiology and cardiology fellowship programs, physicians and hospitals would like to rely on fulfilling the society recommendations and the CBCCT examina-

tion for documentation of proficiency in cardiac CT and coronary CTA. In fact, many physicians in other countries strive for verification and certification of their competency in coronary CTA according to the U.S.-based competency levels 1 to 3, although these competency levels do not apply to their own country and the CBCCT examination is not administered outside the U.S.

Finally, while the models for health care coverage and reimbursement for CTA vary widely through the world, from completely socialized medicine to voluntary insurance, many other barriers remain similar. As an example, a struggle for how to adequately reimburse coronary CT is uniformly evident in all countries. It is so because the test is new and if reimbursed without restrictions overuse becomes a possibility. Cardiac CT imaging is substantially more complex than body CT, but not all reimbursement systems provide for organ-specific compensation of CT imaging procedures. In the majority of European countries with largely socialized systems of medicine, cardiac CT examinations are reimbursed or radiologists continue to bill for a chest CT procedure (Table 1); reimbursement is usually substantially lower in Europe. For instance, the reimbursement for a cardiac CT scan (or chest CT examination) is approximately €400 in Germany or Finland, but as low as €150 in Italy. Low reimbursement rates make it impossible to operate high-end CT equipment exclusively for cardiac imaging and restrict CT imaging to radiology settings, wherein a higher volume of procedures and a lower average time spent per CT exam help cover operating costs. Given the legal and economic framework, it can be expected that the U.S. will eventually al-

low a rapid penetration of cardiac CT imaging in clinical cardiology. Large cardiology group practices, often hospital-based, are not very common in Europe, and it is difficult for cardiologists to be involved in high-volume cardiac CT operations. Regardless, it will be mandatory in all countries that regulations are enforced that are neither too restrictive nor liberal, and reimbursement be allowed that is sufficiently attractive to encourage appropriate use and discourage overutilization. This will ensure that everyone who really needs a cardiac CT examination will be able to obtain the test.

Despite practice and policy differences across the shores, the common theme should be providing the best test to most patients in the most efficient and economically-viable manner. Hard science is the foundation for development of meaningful recommendations and guidelines. We, the physicians involved in cardiac imaging, must collect evidence that will help identify patients most likely to benefit from coronary CTA. We

also need to define technological requirements that will ensure sufficient image quality with minimum ionizing risk, and develop the level of expertise for adequate performance and interpretation of the study. This applies to all countries and continents. With the rapid globalization of medical information, we should not hesitate to learn from one another. We should learn to share and, more importantly, use the evidence collected in other countries. We should learn to collaborate and work together to create stronger databases that will help guide coronary CTA in the right direction. We do not believe that the Atlantic is still unfathomable especially when the world has become so flat (3)!

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REFERENCES

1. Weinreb JC, Larson PA, Woodard PK, et al. American College of Radiology clinical statement on noninvasive cardiac imaging. *Radiology* 2005;235:723-7.
2. Budoff M, Cohen MC, Garcia MJ, et al. ACCF/AHA clinical competence statement on cardiac imaging with computed tomography and magnetic resonance. *J Am Coll Cardiol* 2005;46:383-402.
3. Friedman TL. *The World Is Flat: A Brief History of the Twenty-First Century*. New York, NY: Farrar, Straus and Giroux, 2005.