EDITORIAL COMMENT
Cardiac Magnetic Resonance Imaging and Core Cardiology Training II (COCATS-2)
Can We Get There From Here?*
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The recently published revision of the Adult Cardiovascular Medicine Core Cardiology Training document (Core Cardiology Training II, or COCATS-2) in the Journal of the American College of Cardiology included recommendations on training in cardiovascular magnetic resonance imaging (CMR) for the first time (1). These recommendations reflect the recognition that CMR is a rapidly emerging technology of great relevance to the future of cardiology. In terms of capabilities, CMR has finally arrived after a long incubation period similar to those that occurred in echocardiography and nuclear cardiology. Given dramatic advances in CMR science and technology and a renewed focus on technical needs for clinical application by industry, CMR now offers a unique combination of capabilities to depict many different properties of cardiac tissue and blood, characterized by high resolution, consistently high image quality, three-dimensional coverage, and speed. The results include the highly reproducible and accurate assessment of right and left ventricular volumes, function, wall motion, and mass; three-dimensional strain imaging; rapid, quantitative, and comprehensive assessments of myocardial viability; the presence and extent of infarction; rapid high-resolution rest and stress perfusion, including absolute quantitation, dobutamine stress wall motion studies with and without tissue tagging, multiaxial cardiovascular flow velocity, and flow volume quantitation across large regions of interest; and high-quality magnetic resonance angiography (MRA) of the aorta, carotid, renal, and peripheral arteries. Cardiovascular magnetic resonance imaging also is an extremely powerful tool for the assessment of congenital heart disease, pericardial disease, and intracardiac masses. Coronary MRA is still evolving, but useful, in selected applications such as the detection of anomalous coronary artery origins, bypass graft evaluation, and noninvasive screening for left main or proximal three-vessel disease. Imaging of atherosclerotic plaque and plaque composition is providing new research insights and may have clinical relevance in the future. The newest frontier, which currently is being explored largely in experimental models, is use of real-time CMR with external coils and with catheter and guidewire coils in invasive angiographic and electrophysiologic procedures, with projection as well as tomographic imaging. These efforts include interventions in which CMR tissue characterization has unique value, such as the depiction of radiofrequency tissue injury in ablation procedures and the monitoring of myocardial injections of cell therapy into infarcted, hibernating, or ischemic regions by using cell labeling with magnetic resonance contrast agents. Such developments have made CMR an exceptionally powerful tool for cardiac imaging, now and in the future, while dramatic advances in imaging speed, including real-time imaging, have made it practical.

Cardiovascular magnetic resonance imaging already has had an important impact on both basic and clinical cardiovascular research, literally bench to bedside, providing high-quality imaging of mice and men alike. It has reduced sample sizes in both basic research and clinical trials and has provided compelling results unavailable by other techniques. It is highly likely to have a widespread major impact in clinical diagnostic imaging in the coming years, improving risk stratification and clinical decision-making. Despite the high capital cost of the equipment, it is already apparent that downstream improvements in the application of expensive therapies to the right patients will more than repay such investment. In a few centers with substantial CMR expertise and resources, CMR has already become a preferred approach in pharmacologic stress testing, in viability assessment, in the determination of ventricular and atrial structure and function, and in the evaluation of congenital, pericardial, and valvular disease. As evidence of the attractive performance characteristics of CMR mounts and multicenter trials with clinical relevance begin to accrue, the need for expanded training opportunities has become widely recognized. Indeed, existing fellowship and CME opportunities to train in CMR are substantially oversubscribed, with some U.S. cardiologists seeking training abroad for extended periods. Limitations on training opportunities beyond the core cardiology fellowship experience are only one of a thicket of barriers to entry in the field. In some places, turf wars between radiologists and cardiologists have been disabling. Unreasonably low reimbursement, whether by comparison with other MRI procedures or to other cardiac imaging procedures on a time and resource cost basis, has created an economic barrier in many settings. Core Cardiology Training II raises the question whether there also may be barriers to entry within cardiology training programs.

The CMR training recommendations in COCATS-2

*Editorials published in the Journal of the American College of Cardiology reflect the views of the authors and do not necessarily represent the views of JACC or the American College of Cardiology.

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follow the same approach used in echocardiography and nuclear cardiology, with three levels of training described and outlines of curricula and content for each. In level I training (one month), the trainee is provided a working knowledge of CMR methods but not the skills to perform CMR. In level II (three months) he or she is provided the skills to interpret CMR studies in a center directed by an individual with more extensive training and experience. In level III (one year), the trainee is provided sufficient in-depth expertise to form the basis for an academic career in CMR and/or to direct a CMR facility. Analogous criteria for training and experience for established cardiologists in practice who have completed fellowship training and seek to enter the field have been published by the Society for Cardiovascular Magnetic Resonance (SCMR), an international society whose membership includes radiologists, nuclear medicine specialists, basic scientists, and engineers, although majorities are cardiologists and U.S. based. The substance of the SCMR recommendations in turn have been incorporated into CMR laboratory accreditation standards by the Intersocietal Commission for the Accreditation of Magnetic Resonance Laboratories, a member of the Intersocietal Accreditation Commission analogous to those that exist for echocardiography (i.e., Intersocietal Commission for the Accreditation of Echocardiography Laboratories), nuclear cardiology (i.e., Intersocietal Commission for the Accreditation of Nuclear Medicine Laboratories), and vascular laboratories (i.e., Intersocietal Commission for the Accreditation of Vascular Laboratories). So far, so good.

However, educational recommendations are only as good as the ability to implement them. In this issue, the Journal publishes a sobering report of a survey on training resources in CMR and in vascular imaging, another new component of COCATS-2 (2). Nuclear cardiology resources also were assessed to “calibrate” the data. The report, by Taylor et al. for the Imaging and the Training Directors’ Committees, reflects a survey of cardiovascular training programs, to which more than 50% of programs responded. The results depict an alarming shortfall in the ability of fellowship programs to provide even a bare minimum level I introduction to CMR, much less sufficient training to actively apply this powerful emerging technology in practice. Only 13% of programs had CMR scanners within cardiology, and only 29% provided even an average of eight days of dedicated CMR education at level I! Most had no formal curricula in the field.

But it gets worse. In many programs reporting that they did have CMR available, only imaging of the aorta was performed. Less than 50% of programs identified capabilities for imaging myocardial function, <40% could offer perfusion imaging or viability imaging, and <30% could offer coronary MRA or assessment of valvular disease. These sobering statistics indicate that the present generation of cardiology trainees will not be prepared on completion of training to apply CMR effectively.

This sad story does not reflect any lack of appreciation of the value of CMR, because it ranked nearly as high as nuclear cardiology (4.9 ± 1.4 vs. 5.7 ± 1.3 on a seven-point scale in importance in the eyes of the respondents). Rather, it reflects several underlying issues. First, the report indicates that in most centers that have any CMR, both the physical and training resources are likely to reside outside of cardiology divisions, in the radiology departments. Well, one might say, from the perspective of the public interest, what difference does it really make where the resources and expertise lie? However, this is not simply a turf issue. The reality is that given the progressive integration of angiography, echocardiography, and nuclear imaging into the fabric of cardiology education and practice during the last 50 years, most radiology departments are by now largely devoid of expertise in cardiac imaging, whereas only a handful of bona-fide CMR-capable cardiovascular radiologists are to be found in major centers in the U.S. Indeed, one could argue that the deficit in CMR expertise is far greater in radiology than in cardiology relative to availability of the technology. Thus, in most centers, the knowledge base with regard to cardiac physiology, pathophysiology, and expressions of disease resides largely in cardiology, whereas technical expertise in MRI resides largely in radiology. Unless a robust, effective interface is developed between the two or cardiology has the resources and influence within the institution to acquire both expertise and technology, the result is an ineffective minimal program in CMR, such as those doing only MRA of the aorta. The corollary is that, in general, most successful CMR programs and related educational activities have been either very substantive and extensive interactive collaborations between cardiologists and radiologists (the ideal) or, less often, pure cardiology enterprises. Second, there are precious few centers with fellowship faculty with any real expertise in CMR—the chicken and egg problem. Unless educational resources within existing programs can be strengthened substantially, there is little hope of improving the situation.

Where do we go from here? The program directors responding to the survey felt that the greatest need was for didactic material to educate fellows and faculty alike. They rated Web-based didactic material second choice. The authors of the report in turn strongly endorse development of Web-based didactic and case-based educational materials as the only practical alternative for developing core curricular materials at level I but also endorse collaborative relationships between radiology and cardiology and cultivation of local and regional relationships between centers with and without CMR training capabilities. They urge all possible support from the American College of Cardiology (ACC), its Imaging Committee, and that committee’s
Working Group on CMR, as well as more extensive collaboration between the ACC foundation and SCMR to meet these needs.

Such recommendations too often are cast on deaf ears. Happily, ACC’s hearing is acute, and implementation of this strategy is beginning. Formal representation from the SCMR is being added to the ACC’s Imaging Committee. More importantly, the Committee’s Working Group on CMR has developed and obtained ACC support for the development of a Web-based level I “CMRSAP” in collaboration with SCMR to fulfill the needs for level I fellowship training as well as the initial familiarization needs of physicians in practice. Planning for this effort is well underway at this writing under the leadership of W. Greg Hundley, MD, FACC, with a detailed outline and section editors identified and many contributors in place. It will include didactic and case-based teaching approaches. A Spring 2004 completion date is targeted. The results should enable many in cardiology, both trainees and practitioners alike, as well as interested radiologists and nuclear medicine physicians, to take a first step down the path to real expertise in this exciting and rapidly advancing field. Hopefully, this initial effort will be followed by development of additional “CMRSAP” materials to further support level II and level III education in CMR. Then, truly, we will be able to get there from here.

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