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NEWS AND VIEWS

Extracardiac Findings: What Is a Cardiologist to Do?

SINCE THE VERY FIRST CARDIAC IMAGES WERE CREATED, cardiologists have struggled with what to do about "incidental" abnormalities in structures outside the heart. Echocardiographers were among the first to deal with this dilemma in the 1980s once subcostal views became part of a routine examination, because hypoechoic or hyperechoic structures in the liver, gall stones, and calcifications in the abdominal aorta are commonly visualized.

Similar issues confront the nuclear cardiologist (1). Because there is limited guidance on how to handle these findings, each interpreter likely approaches them in a different manner. Whereas some may ignore them, most probably comment along the lines of "abnormality noted, further testing suggested if clinically indicated" and feel that this satisfies their professional and moral obligations to the patient. This approach recognizes a possibly important finding while remaining cognizant of the inadequacy of cardiac images for visualizing and diagnosing noncardiac findings, the interpreter's own possible lack of specific training in recognizing noncardiac imaging pathology, and a vague legal liability for missing "something important."

This approach worked well until the development of cardiac magnetic resonance (CMR) imaging and cardiac computerized tomography (CCT). These techniques routinely visualize noncardiac structures with diagnostic-quality images, so a new solution was necessary. Suggested approaches varied widely, from denial ("just narrow the field of view so you can't see anything beyond the heart") to insouciance ("no one has ever been sued for missing noncardiac pathology on an echo, so why worry about CCT?") to engagement ("let's learn whatever we need to know to interpret all of the findings on the images") (2). The situation has been further intensified by a "turf war" (3), which has targeted a general lack of cardiologists' training in body imaging. Perhaps most importantly, the realization has grown that noncardiac findings can occur with astounding frequency on these newer forms of cardiac imaging, with a substantially large number being clinically significant (4–8). This means that cardiologists can no longer ignore the problem.

Suggested approaches varied widely, from denial ("just narrow the field of view so you can't see anything beyond the heart") to insouciance ("no one has ever been sued for missing noncardiac pathology on an echo, so why worry about CCT?") to engagement ("let's learn whatever we need to know to interpret all *of the findings on the images").*

In addressing this issue, the 2008 revision of cardiovascular fellowship training guidelines (Core Cardiology Training Symposium 3 [COCATS 3]) regarding CCT recommends "the standard use of a small

Table 1 Requirements for CCT Study Performance and Interpretation to Achieve Level 1, 2, and 3 Clinical Competence

	Cumulative Duration of Training	Minimum No. of Mentored Examinations Present During Performance	Minimum No. of Mentored Examinations Interpreted
Level 1	1 month	—	50
Level 2	2 months	35	150
Level 3	6 months	100	300

Reprinted with permission from Budoff et al. (9).

field of view (e.g., limited lung fields) [which] precludes complete evaluation of the entire thorax" along with "specific interpretation of the extracardiac fields." To this end, the guidelines recommend that "Level 2 and Level 3 training should include the review of all CCT cases for noncardiac findings," including "review of a dedicated teaching file of 25 CCT cases featuring the presence of significant noncardiac pathology" as well as "specific lectures on non-CCT pathology" (9). Overall COCATS 3 requirements for CCT are shown in Table 1.

But is this enough? We have invited experts to present their view of what level of expertise and training should be the standard for cardiologists interpreting noncardiac findings, and what the level of clinical accountability should be. What do they have to say? Please go to the American College of Cardiology (ACC) online journal *Cardiosource* and find your favorite *iJACC* (*JACC: Cardiovascular Imaging*) site. Would you share your opinion with us? Would you like to start a debate? We value your opinion. The opinions presented herein are entirely of the authors and do not reflect or express the position of the ACC, *iJACC*, or the editors.

Pamela S. Douglas, MD, MACC
Duke University Medical Center, Durham, North Carolina

Cardiologists Should Be Able to Interpret Extracardiac Findings

Manuel Cerqueira, MD, FACC
Cleveland Clinic, Cleveland, Ohio

REGARDLESS OF IMAGING MODALITY, extracardiac information should be reviewed in detail, with an awareness of the limitations imposed by maximizing the imaging for the heart, and the results reported as part of the cardiovascular imaging examination. Based on their training in internal medicine and cardiovascular anatomy, physiology, and imaging, cardiologists, with additional time spent training using case material devoted to extracardiac findings, are best qualified to perform all aspects of cardiovascular imaging, including the incidental findings. This approach will improve efficacy and efficiency of cardiovascular imaging by allowing 1 individual to interpret and report the entire procedure.

Cardiologists are best qualified to perform all aspects of cardiovascular imaging, including the incidental findings.

What is the true prevalence of significant extracardiac findings on CCT and CMR and should we be looking? The true prevalence of significant extracardiac findings with CCT and CMR varies and is strongly influenced by patient selection. In predominately symptomatic patients with a mean age of 59 years and using electron beam computed tomography (EBCT), some type of extracardiac findings was present in 39%, with bronchial carcinoma confirmed in 2 individuals (0.1%) (10). Using 16- or 64-slice multidetector computed tomography (CT) scanners, Onuma et al. (4) found extracardiac findings in 58%, with 22.7% being clinically significant. There were 4 cases (0.8%) of malignancy. Using EBCT in a screening population, the incidence of clinically significant findings requiring follow-up was significantly lower, at 7.8% (11). Because questions remain about the benefits of screening for lung cancer itself (12), the significance of these abnormal findings on CCT remains unknown.

Questions remain whether to use a small field of view to maximize the spatial resolution for CCT angiography or to widen the field and include the lungs, mediastinum, and bone structures (2,13). Regardless of the absolute number of extracardiac findings, there is a high enough prevalence that review of the available extracardiac CCT data is required, with the awareness that this may lead to further, and sometimes unnecessary, testing. The lungs, mediastinum, bones,

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upper abdomen, and breast are within the field of view and should be reviewed using appropriate mediastinal, bone, and lung windows for the full field of view acquired and using appropriate slice thickness. Cardiologists can be trained to read these structures and note abnormalities.

Are there technical limitations to extracardiac findings on CCT and CMR? Any discussion of incidental extracardiac findings detected during imaging of the cardiovascular system must consider the basic fact that optimal performance of cardiac evaluation, especially the coronary arteries, may be suboptimal for detection of extracardiac abnormalities. In fact, the acquisition parameters essential for good-quality CCT and CMR may create artifacts that lead to erroneous findings. Such limitations are especially a problem when trying to perform a "triple threat" evaluation in the emergency department. This approach is preferable to trying to eliminate or blurring the extracardiac structures to limit liability under the theory that you cannot be held responsible for what you cannot see.

Such technical limitations exist regardless of whether the interpreting physician is a cardiologist or a radiologist. To date, issues of "turf" have unfortunately not allowed a dialogue which could catalog extracardiac artifacts seen with CCT and CMR and develop a consensus on acquisition and processing parameters that give the best possible cardiac examination while optimizing the accuracy of extracardiac findings (3).

What level of training? Radiologists have the most extensive and appropriate training in whole-body imaging for identifying the extracardiac findings associated with cardiovascular imaging, but less training in cardiac anatomy, physiology, and clinical diagnosis and management of cardiac and other disease states. The American College of Radiology (ACR) recognizes these limitations and has published a clinical statement and a practice guideline for cardiac imaging (14,15). The ACC and American Heart Association (AHA) have also defined training and competence for cardiologists wishing to perform CCT and CMR (9,16,17). The training and experience requirements for radiologists and cardiologists for performance and interpretation of cardiac findings are very similar (18).

In contrast, there is no consensus among cardiologists and radiologists regarding the extracardiac findings, and even within the cardiology community there are contradictory standards. The ACC/AHA training guidelines (COCATS 3) offer minimal time and case requirements beyond exposure to 25 cases (9). Many cardiologists have the extracardiac findings over-read by radiologists, but this practice is fraught with legal issues that have not been resolved (19,20). Nuclear medicine physicians (Society of Nuclear Medicine and the American College of Nuclear Physicians) have defined more stringent hour and case load requirements for credentialing and delineation of privileges for the interpretation of CCT, CT performed in conjunction with hybrid positron emission tomography (PET), and single photon emission computerized tomography/CT systems (21,22). These requirements allow interpretation not only of the chest and abdomen, but of all other areas of the body when performed with oncologic PET studies. These training requirements include completion of sufficient training and experience to meet the qualifications of the "ACR Practice Guideline for Performing and Interpreting Diagnostic CT" (14,16). For a physician who assumes responsibilities for CT imaging exclusively in a specific anatomical area, such as cardiac CT, this includes:

1. Completion of an Accreditation Council for Graduate Medical Education (ACGME)–approved training program in the specialty practiced plus 200 h of category I continuing medical education (CME) in the performance and interpretation of CT in the subspecialty where CT reading occurs.
2. Supervision, interpretation, and reporting of 500 cases, at least 100 of which must be a combination of thoracic CT or thoracic CT angiography during the past 36 months in a supervised situation. Coronary artery calcium scoring does not qualify as meeting these requirements.
3. Included in the above, completion of at least 30 h of category I CME in cardiac imaging, including CCT, anatomy, physiology, or pathology or documented equivalent supervised experience in a center actively performing cardiac CT.
4. The interpretation, reporting, or supervised review of at least 50 cardiac CT examinations in the last 36 months. Coronary artery calcium scoring does not qualify as meeting these requirements.

With the appropriate training as outlined above, cardiologists should have the knowledge and skills to properly interpret extracardiac findings observed on CCT and CMR.

Only Appropriately Trained Physicians Should Interpret Extracardiac Pathology

Geoffrey D. Rubin, MD FSCBTMR
Anne Shu-Lei Chin, MD
Stanford University,
Stanford, California

THE RECENTLY PUBLISHED COCATS 3 FELLOWSHIP TRAINING REQUIREMENTS FOR CCT is unequivocal in its statement that the interpretation of extracardiac structures should be performed (9). Extracardiac findings detected with CCT are reported to be very common (4–8) for multidetector CT. At least 4% of incidental findings have an immediate impact on patient management (4,5,7) and include unsuspected lung carcinoma, breast carcinoma, pulmonary embolism, pneumonia, mediastinitis, aortic aneurysm, aortic dissection, and sarcoidosis.

If we accept that the detection and management of extracardiac findings are important and likely to increase in prevalence as cardiac CT use increases in emergency departments and inpatient populations, then a key question is the level of experience and education that qualifies a cardiac imager to interpret extracardiac findings in CCT scans. Normally, the process of image interpretation is 3-fold: lesion detection, lesion characterization, and management recommendation. In the COCATS 3 document, training for the "recognition" of extracardiac findings is endorsed and once detected "require[s] referral to a specialist or radiologist with expertise in chest imaging." This recommended workflow suggests that for a "cardiovascular medicine specialist" performing CCT, the standard 3-fold image interpretation process be distributed between 2 practitioners. Although a discussion of the operational challenges of such a workflow is beyond the scope of the present brief communication, there are pertinent training implications. Given that the majority of incidental extracardiac findings are clinically insignificant, a basic understanding of the characteristics of truly insignificant findings should augment the training on lesion detection. The latter task notably includes the detection of pathological processes as well as their exclusion through an in-depth understanding of normal anatomy, variant anatomy, and imaging artifacts.

One-on-one image interpretation sessions with experts, supplemented with didactic lectures and teaching files, has been the hallmark of effective training for image interpretation through residency and fellowship. Book learning and didactics have their role, but throughout the practice of medicine there is no substitute for "in the trenches" training with real-time decision making. General competencies for cardiothoracic imaging within the context of a diagnostic radiology residency have been published (23). In general, graduates of ACGME-accredited radiology residency programs will have performed supervised interpretations of approximately 1,000 to 3,000 chest CT scans with an additional 1,000 to 3,000 supervised interpretations during an additional year of "body imaging" fellowship. These scans are acquired in diverse clinical settings, including general inpatient, outpatient, emergency department, and intensive care units. Teaching files are available that illustrate the manifestations of disease on chest CT scans and supplement actual case experience. For example, there are 2,600 adult chest CT teaching cases available online (24).

In comparison, Level 2 competency, defined by COCATS 3 as the minimum recommended training for a physician to independently perform and interpret CCT, requires the review of a dedicated teaching file of 25 cardiac CT cases featuring the presence of significant noncardiac pathology, as well as the review of 150 CCT exams for incidental findings (9). This experience is approximately 2% to 10% of the case numbers described above for radiology residency graduates and body imaging specialists. Unlike the supervised cases described in the preceding paragraph, which involve primary scan interpretation and reporting with direct faculty oversight, these 150 "mentored examinations" may include up to 115 "studies from an established teaching file, previous CCT cases, journals and/or textbook, or electronic/online courses/continuing medical education," whichare unlikely to highlight extracardiac abnormalities. This leaves a requirement of only 35 CCT scans for directly supervised primary interpretation. For Level 3 competency, sufficient to "serve as a director of an academic CCT section," the requirement for directly supervised primary interpretation increases to 100 CCT scans. Therefore, assuming a prevalence of important extracardiac findings of 5% to 10%, if a cardiovascular medicine trainer meeting minimal Level 3 standards carries out the CCT training, then the sum total of the trainer's experience in the active interpretation of extracardiac findings would be 10. In our opinion, this is too few.

There are no data to establish the optimal volume of supervised interpretations and didactic learning for effective identification of significant extracardiac abnormalities on chest CT scans. However, having participated in the formal training of over

250 physicians to interpret chest CT scans, our experience leads us to several conclusions:

1. Virtually all radiology residents can be trained to competently interpret thoracic CT scans.
2. Interested trainees in other medical fields, such as cardiovascular medicine, have similar aptitude as radiology trainees to competently interpret medical images. All they lack is appropriate training.
3. The educational value of supervised interpretation is directly related to the expertise of the supervising interpreter.

Thus, nothing precludes a cardiovascular medicine specialist from becoming a competent interpreter of extracardiac abnormalities on a CCT scan. However, their training must be performed by experts in the interpretation of extracardiac abnormalities and must have sufficient clinical exposure to understand the spectrum of normalcy, disease, and pseudodisease that may be seen on a CCT scan. Current COCATS 3 recommendations do not provide for either.

COCATS 3 . . . training recommendations are insufficient to expose the trainee and the trainer to the complexity and depth of pathology that exists outside the heart and assure detection of all important abnormalities.

In summary, although COCATS 3 specifically calls for the detection of noncardiac abnormalities with referral for management decisions to chest imaging experts, the training recommendations are insufficient to expose the trainee and the trainer to the complexity and depth of pathology that exists outside the heart and assure detection of all important abnormalities. Moreover, in the circumstance where a chest-imaging expert is not available for consultation, inaccurate or insecure diagnoses may result in unnecessary patient anxiety, follow-up, and referral.

Please note that Dr. Chin is currently affiliated with McGill University.

Author Disclosures

Dr. Cerqueira is the current President of the Certification Board of Cardiovascular CT.

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Key Words: multimodality imager ■ imaging fellowship training ■ extracardiac findings ■ incidental findings ■ over reading images.