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EDITORIAL COMMENT

Appropriate Use Criteria

Another Step Forward But Still a Ways to Go*

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Most cardiologists are familiar with appropriate use criteria (AUC). The American College of Cardiology Foundation (ACCF) has developed AUC for each of the major noninvasive cardiac imaging modalities (1–5). A handful of studies have examined the application of AUC in clinical practice (6–11).

In this issue of the *Journal*, Hendel et al. (12) report the results of the most comprehensive application of the AUC to date. These authors deserve credit for developing and promoting AUC. Their current project evaluates the use of a computer-based algorithm to assess the appropriateness of single-photon emission computed tomography myocardial perfusion imaging (SPECT MPI) in 6,351 patients. As such, this study has 2 components that can be analyzed separately: 1) the application of this tool in clinical practice; and 2) the AUC ratings that were assigned.

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The first major finding of this study is the demonstration of the feasibility of prospectively applying AUC using a computer-based tool at the point of ordering in a real-world setting encompassing 6 private practices. This approach was successful, resulting in 93.3% of patients being assigned a rating category. The novel study design differs from earlier studies that retrospectively examined AUC in single academic medical centers (6–11). Another strength of this study is the use of a computer-based algorithm. Third-party payers are more frequently requiring preauthorization by radiology benefits managers, a process that is time-consuming and frustrating for patients and caregivers. A computer algorithm should provide a more rapid, objective, and consistent determination of appropriateness classification (and approval or denial of payment).

A limitation of the approach applied by Hendel et al. (12) concerns missing data. In the 6.7% of the population that could not be assigned an appropriateness indication, the reason was incomplete data in 75.6%. Coronary heart disease (CHD) risk could not be calculated in 17% of patients, and some dates for revascularization procedures were not available. The inability to collect complete data for common clinical variables at the point of ordering highlights that application of AUC is not necessarily simple.

A second major finding is the distribution of AUC categories: 70.7% appropriate, 14.9% uncertain, and 14.4% inappropriate. The 3 most common indications for performing SPECT MPI (chest pain after revascularization; chest pain with inability to exercise or uninterpretable electrocardiogram; chest pain with intermediate pre-test probability of CHD, able to exercise, and interpretable electrocardiogram) are all rated appropriate and accounted for nearly half of the studies ordered. Five clinical scenarios characterized primarily by asymptomatic status accounted for 92% of inappropriate studies.

These results are similar to what has been reported at academic medical centers (6,7). In these earlier studies, there was no possibility of altering physician test-ordering behavior due to their retrospective study design. However, in this prospective study (12) it is possible that behavior may have been modified. Physicians might have avoided ordering inappropriate studies simply in response to knowing that they were being monitored (the Hawthorne effect) (13), or they could have been actively coached to do so by their practice site principal investigator. No information is provided regarding dissemination of awareness of AUC among these practices.

Some unique findings from this study warrant comment. The prevalence (47.5%) of previous coronary revascularization is considerably higher than prevalences of 6% to 34% reported in previous studies of SPECT MPI (6,7,14,15). The significance of this observation relates to the application of Table 7 (Risk Assessment: Post-Revascularization) in the SPECT MPI AUC document (1). Only 1 of the 9 clinical scenarios listed in this table is rated inappropriate. Thus, simply selecting a population with a high prevalence of previous revascularization should bias AUC ratings in favor of fewer inappropriate studies. Another issue relates to data from this study that were presented during the American College of Cardiology (ACC) 2009 annual meeting but are not included in this paper. A slide was shown that demonstrated that CHD risk categories were shifted toward a higher risk based on physicians' estimates of CHD risk versus directly measured CHD risk: high risk, 36% versus 25%; moderate risk, 32% versus 9%; low risk, 32% versus 66% (16). One interpretation of these findings is physicians believed that they were referring higher-risk patients for testing. Because physician behavior may have been altered

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during this study, the reported distribution of AUC categories should be interpreted with caution. This same caveat applies to comparisons of cardiologists versus noncardiologists and physicians within versus those outside the practice. Including control sites where physicians ordering SPECT MPI were unaware of monitoring could have addressed these issues but would have necessitated a more complex study design.

Hendel et al. (12) note similarities between the ACCF AUC and the ACC/American Heart Association (AHA) guidelines. However, the AUC approach is primarily opinion based, whereas the guidelines process is more evidence based (comprehensive literature review and level-of-evidence grading scheme). Several apparent discrepancies exist for clinical scenarios rated appropriate by AUC but assigned a Class IIb or III indication by the guidelines. Evaluation of symptomatic patients at intermediate or high pre-test probability of CHD who have an interpretable electrocardiogram and are able to exercise is an example. ACC/AHA guidelines (17) assign stress imaging a Class IIb indication as the initial test in this setting because standard treadmill testing can accurately risk stratify the majority of these patients and is lower cost. Another example includes risk stratification of asymptomatic diabetic patients. AUC designate diabetes status as high CHD risk and, therefore, assign a rating of appropriate to SPECT MPI for screening purposes in all diabetic patients. Although several studies have demonstrated that SPECT MPI can risk stratify asymptomatic diabetic patients (18), guidelines assign ratings of Class IIb or III because no study has shown that routine application of stress imaging in this setting leads to improved patient outcome, including the recently published DIAD (Detection of Ischemia in Asymptomatic Diabetics) trial (19). If AUC adopted a more evidence-based guidelines approach, the distribution of AUC categories in this study (12) would have shifted toward more inappropriate studies.

The actual number of inappropriate cardiac imaging studies being performed in the U.S. remains unknown. Between 1993 and 2001, the rate of growth of stress imaging was steep (6% annually) and far exceeded modest rates of growth of coronary angiography or revascularization, whereas the incidence of myocardial infarction was constant (20). These findings suggest that the number of normal SPECT MPI studies has dramatically increased, likely due to expanded use of imaging in low-risk patients. A recent publication implies that self-referral has contributed to this growth. Private office use of SPECT MPI by cardiologists increased 215% and Medicare Part B payments to cardiologists increased 301% between 1998 and 2006 (21).

We believe that the AUC process could be improved by addressing the following issues. 1) The formal definition of "appropriate" (22) should be revised to incorporate financial cost as a negative consequence of performing an inappropriate study. 2) Rating panels should be more heterogeneous and include more nonimagers to achieve better balance in the voting process. 3) AUC clinical scenarios included for rating assignments should be reassessed, eliminating "straw man" indications that are never used (e.g., resting SPECT MPI in acute ST-segment elevation myocardial infarction) (1) and instead including common uses in practice that are not addressed (e.g., resting echocardiogram for determination of ejection fraction in a patient with chest pain and a normal electrocardiogram) (4). 4) The AUC ratings process should be more rigorous. AUC voting panels are instructed to assign a rating of appropriate if imaging is "reasonable" to perform for a given clinical scenario. A rating assignment of appropriate should be supported by medical evidence.

Noninvasive imaging plays a major role in the evaluation and management of patients with CHD. The most efficient use of noninvasive testing involves matching the right test to the right patient. The rapid rate of growth of cardiac imaging suggests overuse, creating waste in the medical system. Controlling costs by selectively eliminating expensive imaging procedures in low-risk patients should be much more palatable to patients and physicians than draconian across-the-board reductions in reimbursement enacted by the Centers for Medicare and Medicaid Services. An unfortunate consequence of this latter approach is denial of imaging procedures to higher-risk patients who can clearly benefit from this technology. Hendel et al. (12) have demonstrated a practical and efficient method to facilitate application of AUC in clinical practice. Strengthening the AUC ratings process would enhance the credibility of using AUC to control medical costs.

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