ACR Appropriateness Criteria Asymptomatic Patient at Risk for Coronary Artery Disease

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Atherosclerotic cardiovascular disease is the leading cause of death for both men and women in the United States. Coronary artery disease has a long asymptomatic latent period and early targeted preventive measures can reduce mortality and morbidity. It is important to accurately classify individuals at elevated risk in order to identify those who might benefit from early intervention. Imaging advances have made it possible to detect subclinical coronary atherosclerosis. Coronary artery calcium score correlates closely with overall atherosclerotic burden and provides useful prognostic information for patient management. Our purpose is to discuss use of diagnostic imaging in asymptomatic patients at elevated risk for future cardiovascular events. The goal for these patients is to further refine targeted preventative efforts based on risk. The following imaging modalities are available for evaluating asymptomatic patients at elevated risk: radiography, fluoroscopy, multidetector CT, ultrasound, MRI, cardiac perfusion scintigraphy, echocardiography, and PET.

The ACR Appropriateness Criteria are evidence-based guidelines for specific clinical conditions that are reviewed every 2 years by a multidisciplinary expert panel. The guideline development and review include an extensive analysis of current medical literature from peer-reviewed journals and the application of a well-established consensus methodology (modified Delphi) to rate the appropriateness of imaging and treatment procedures by the panel. In those instances where evidence is lacking or not definitive, expert opinion may be used to recommend imaging or treatment.

Key Words: Appropriateness criteria, coronary artery calcium score, coronary artery disease, asymptomatic, multidetector CT (MDCT)

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SUMMARY OF LITERATURE REVIEW

Introduction/Background

In the United States, atherosclerotic cardiovascular disease (CVD) is the leading cause of death for both men and women [1]. Although improvements in awareness, knowledge, and medications have led to a decrease in death rates, the burden of disease remains very high [1,2]. Because atherosclerotic coronary artery disease (CAD) has a long and asymptomatic latent period, it is believed that early targeted preventive measures would

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be a great benefit to reducing mortality and morbidity. To identify patients who might benefit from early intervention, it is essential to accurately classify individuals who are asymptomatic but at elevated risk.

CVD prevention has traditionally been based on the assessment of a patient's conventional risk-factor profile, a combined evaluation based on genetic, social, physiological, and environmental factors [3]. Risk assessment for CAD is intended to aid in determining the appropriate lifestyle changes and pharmacological interventions to reduce a patient's risk of cardiac death. A global risk score, such as Framingham, Reynolds, Systematic Coronary Risk Evaluation, or Prospective Cardiovascular Munster, is used to categorize patient risk as low, intermediate, or high. However, these risk factors are strong population-based markers but poor individual discriminators of CAD disease, and many individuals with 1 or more risk factors do not experience a cardiac event [3].

There is a growing discordance between the recognized ability of current risk estimation tools to predict outcomes versus that of actual measured outcomes [4]. Recent imaging advances have made it possible to detect subclinical coronary atherosclerosis. The coronary artery calcium score (CACS) is a marker of vascular injury that correlates closely with the overall atherosclerotic burden. Individual data derived from this and other imaging tests provide useful prognostic information for patient management and can complement current risk prediction models.

Nonimaging-based diagnostics, such as exercise treadmill testing, are also used for assessing asymptomatic patients who have an elevated risk for CVD. The added value of imaging-based tests has been previously established; therefore, a discussion of the use of nonimaging-based tests is beyond the scope of this document. Our purpose is to discuss the use of diagnostic imaging tests in asymptomatic patients who are at elevated risk for future cardiovascular events. The assessment goal for these patients is to further refine targeted preventative efforts based on patient risk. Diagnostic imaging tests are used only in asymptomatic patients at elevated cardiovascular risk. (Imaging use in patients who have a known diagnosis of CAD, cardiac symptoms, history of a coronary event, or prior intervention can be found in other ACR Appropriateness Criteria®.)

The following imaging modalities are available for evaluating asymptomatic patients at elevated risk for CAD: chest radiography, chest fluoroscopy, multidetector CT (MDCT), ultrasound, MRI, cardiac perfusion scintigraphy, echocardiography, and PET.

Chest Radiography

A chest radiograph is commonly used in asymptomatic individuals as part of a routine physical examination or presurgical testing. A routine chest radiograph can detect unsuspected abnormalities of the lungs and thorax, assess for cardiomegaly, detect coronary calcium, or serve as a baseline for future measurement. Radiographs of the chest can depict the presence of coronary artery calcifications, which are indicative of CAD. Radiographic analyses of living and autopsied patients have demonstrated that coronary calcification is easily detected, occurs frequently, increases with age, and can indicate severe underlying lesions [5-8]. There is also an association between aortic arch calcification depicted on chest radiography and CAD [9].

Chest Fluoroscopy

Fluoroscopic visualization of coronary calcification is a noninvasive method used mainly in the past as a screening technique for CAD. The prevalence of CAD in patients with fluoroscopically detected coronary artery calcifications is significantly greater than in those without calcifications [10]. When compared with coronary angiography, chest fluoroscopy of an asymptomatic military flight crew demonstrated an overall sensitivity and specificity of 66.3% and 77.6%, respectively, for detecting significant CAD [11]. Patients who have calcification detected by chest fluoroscopy also have a significantly poorer survival [12].

CT: Coronary Artery Calcium Scoring

CACS, performed on either an electron-beam CT or MDCT, is a proven marker for the presence of coronary atherosclerosis and risk of future cardiovascular events [13,14]. CACS is useful in risk stratification and reclassification, as a strong association has been found between the calcium score and future mortality and/or adverse cardiac events [15-17]. Many trials have found evidence of the prognostic use of CACS. Shaw et al [18] followed 10,377 asymptomatic patients for 5 $\pm$ 3.5 years and found CACS to be an independent predictor of death that increased proportionally relative to baseline, with an adjusted relative risk of 1.6, 1.7, 2.5, and 4 for CACS 11 to 100, 101 to 400, 401 to 1,000, and $>$1,000, respectively.

CACS provides incremental prognostic information beyond traditional risk factor evaluation. In the St. Francis Heart Study, a CACS $>$100 predicted CAD events independently of standard risk factors [15]. Kondos et al [19] found that any measurable coronary calcium was independently related to hard (death and myocardial infarction [MI]) and soft (revascularization procedure) events in men and women; this finding provided incremental prognostic information over conventional risk factors. Budoff et al [20] also demonstrated incremental risk beyond age, gender, ethnicity, and cardiac risk factors in evaluating data from 25,253 asymptomatic patients who had a 10-year adjusted survival rate of 99.4% for a CACS of 0 and 87.8% for a score $>$1,000.

CACS can be used to stratify and reclassify patient risk more accurately than traditional methods. In 2 recent large population-based studies, CACS demonstrated