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Coronary Artery Calcium Scoring vs. Exercise Tolerance Testing: Diagnoses and Risk Stratification of ASCVD

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Abstract

- Atherosclerotic cardiovascular disease (ASCVD) is highly prevalent in today's society and contributes to high rates of mortality involved with heart disease.
- The initial assessment of ASCVD and risk stratification concerning the development of an acute coronary event can be performed in a number of ways.
- Current American Heart Association (AHA) guidelines recommend exercise stress testing (ETT) as the initial, noninvasive evaluation of choice.
- However, the accuracy of this test is highly dependent on the patient's endurance, body mass index, and artifact, making analyzation difficult.
- Non-contrast cardiac computed tomography (CT) with coronary artery calcium (CAC) scoring has been shown to be specific and sensitive, however only recommended for further evaluation post ETT, those with insignificant stress test findings, and those unable to exercise.
- The purpose of this study is to determine if CAC scoring is a more useful predictor of ASCVD and acute coronary events compared to exercise stress testing.
- The review of literature compares accuracy, predictability, and cost of ETT versus CAC scoring.
- The results display high sensitivity using CAC as the initial diagnostic test in patients determined as low to intermediate risk for an acute coronary event without significant increase in cost.
- The findings may be used to justify current guidelines or propose alterations to certain patient populations as to which test would be more accurate and cost-effective in the risk stratification of ASCVD.

Introduction

- With recent CDC statistics displaying heart disease as the leading cause of death in the United States, accurate diagnosis and risk stratification of ASCVD is easily justifiable to allow the incorporation of adequate treatment to reduce mortality, morbidity, and healthcare cost related to heart disease.
- The purpose of this study is to determine if CAC scoring is a more useful predictor of ASCVD and acute coronary events compared to ETT considering cost, efficacy and accuracy. The method of evaluation is performed via literature review evaluating current guidelines, systematic reviews, and cross-sectional studies published within the last ten years pertaining strictly to adult individuals.

Statement of the Problem

- Many of today's advancements in medical technology have shown to be more accurate and efficient, but also more costly.
- Studies evaluating the sensitivity and cost-effectiveness comparing ETT and CAC scoring are needed to negate which method of evaluation would be most beneficial assessing risk stratification of an acute coronary event.

Research Questions

- In patients with symptoms of ASCVD, is CAC scoring a more useful or accurate predictor of ASCVD and acute coronary events than exercise stress electrocardiogram?
- In diagnosing ASCVD and assessing risk stratification, is exercise stress electrocardiogram or CAC scoring more cost effective as an initial screening test?

Literature Review

- The review of literature focuses on the assessment of adult patients with the indication for ETT or CAC scoring for risk stratification and diagnosis of ASCVD. Full articles were acquired from the following electronic medical databases: PubMed, The Cochrane Library, CINAHL and Clinical Key with preference given to meta-analysis, systematic reviews, and cross-sectional studies.
- Current NICE guidelines recommend CAC scoring to assess some low-risk chest pain patients, stress imaging for medium-risk, and immediate cardiac catheterization for high-risk. AHA/ACC guidelines suggest ETT for patients considered low to intermediate risk. High risk, specific populations should automatically undergo imaging studies.

The review of literature revealed the following main points:

- Amsterdam et al (2010) demonstrated a sensitivity and specificity of ETT of 70% and 75% respectively and found high sensitivity (100% negative predictive value) with a CAC score of 0.
- Greenland et al (2007) found that a CAC >0 increases a patient's risk of a coronary event by 4-fold (p<.0001) and higher levels of CAC correlated with higher rates of coronary events.
- McClelland et al (2015) concluded the addition of CAC score to the MESA risk score provided significant improvements in risk prediction of ASCVD (C-statistic 0.80 vs. 0.75; p<0.0001) and found the combination of CAC and MESA risk score in predicting 10-year risk within one-half of percent of the actual observed rate.
- Bengrid et al (2013) determined the sensitivity of ETT was lower than CAC (p<0.001) at all stenosis levels, but higher specificity than CAC ≥0-400.
- A study by Purvis et al (2011) concluded the strategy implemented by 2010 NICE results with a sensitivity of 88% and a NPV of 98% for excluding obstructive coronary disease.
- Rozanski et al (2011) determined a decrease in downstream testing and medication cost by 37% and 25% with CAC=0.
- Demir et al (2015) found patients evaluated using ETT compared to those evaluated via cardiac imaging following NICE guidelines to have significantly higher cost (p<0.0001) due to overall higher cost, lesser efficacy, and higher rate of invasive coronary angiography.
- Kelly et al (2011) found opposing results displaying an average increase of \$8300 per 100 patients using NICE guidelines.
- Ramen et al (2012) concluded CAC to be a cost-effective strategy for initial investigation if the prior probability of ASCVD is <30%.

Discussion

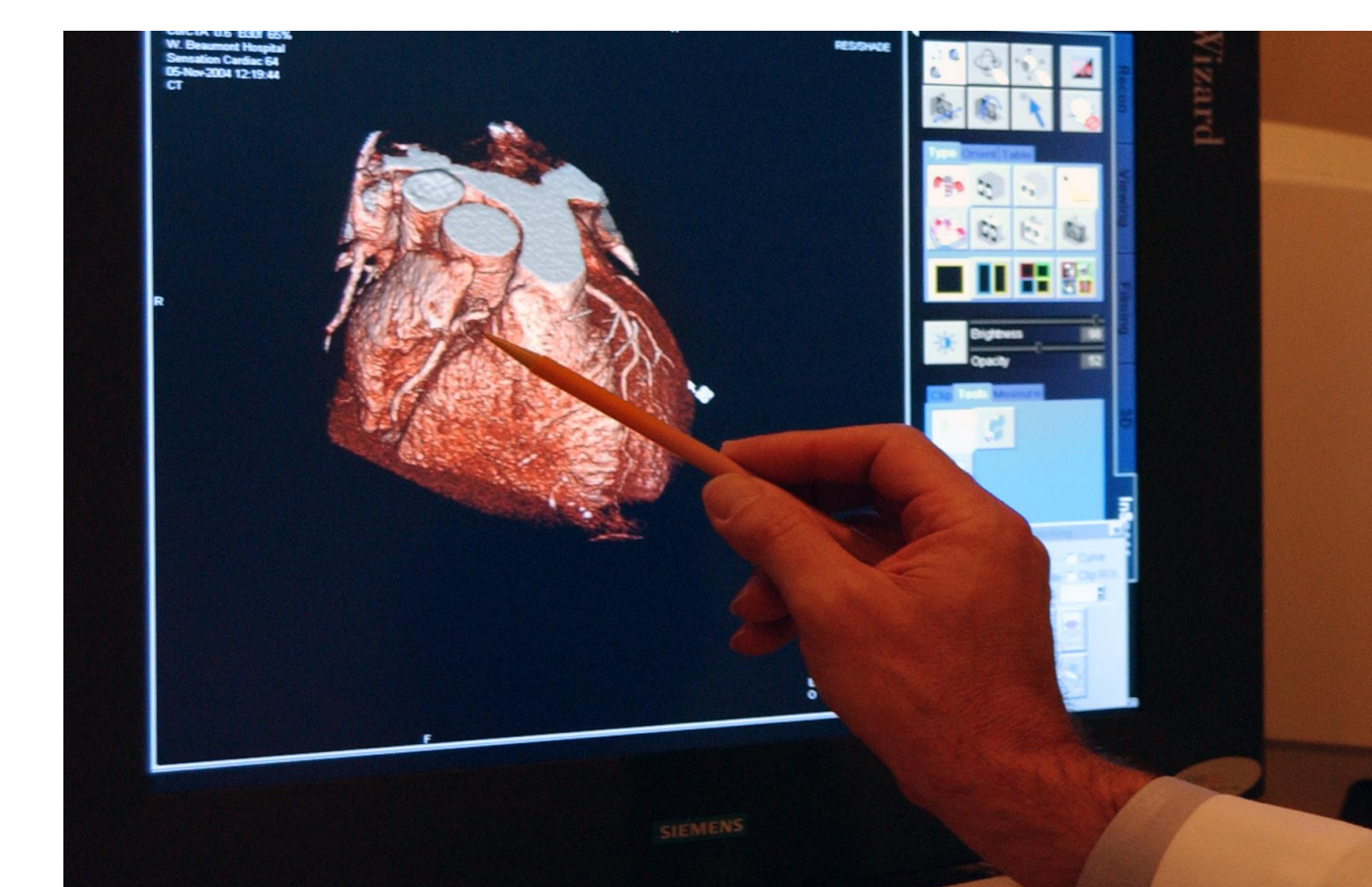
- The results confirmed that both CAC scoring and ETT are effective tools in triaging and evaluating patients with symptoms of ASCVD. The two measurements provide fundamentally different diagnostic information. CAC scoring offers information concerning anatomical defects by assessing calcium in coronary arteries while ETT assesses cardiac function by detecting ischemia during myocardial exertion.
- The data collected demonstrated similarities among effectiveness of studies but also conflicting results. The most recent guidelines and studies based in the UK tend to favor the use of CAC scoring over ETT in patients with low to moderate risk for coronary events contributing to the evident difference in recommendations published most recently by the AHA and NICE.

	ADVANTAGES	DISADVANTAGES
CAC Scoring	<ul style="list-style-type: none"> High Sensitivity (97%) with nearly 100% NPV Lower rate of downstream testing and medication cost Prognostic value with degree of CAC Ability to detect other causes of angina (valve calcification, effusion, thickening) Few contraindications (pregnancy, weight limits) Assess anatomical defects 	<ul style="list-style-type: none"> Lower Specificity (26%) Radiation exposure (1mSv) Higher cost Less accessibility May be unnecessary when hard evidence (elevated LDL, low HDL, history) is noted and will not alter treatment or compliance
ETT	<ul style="list-style-type: none"> Higher Specificity (53.7%) Easily accessible Lower cost No radiation Assess functional capacity 	<ul style="list-style-type: none"> Low Sensitivity (38.9%) High false positive rate (common in females, diabetics, and LBBB) Results are operator dependent Results are limited and dependent upon exercise tolerance, disability, medications, previous EKG changes Many contraindications: acute MI within 2 days, unstable angina, hemodynamic compromise, uncontrolled arrhythmia, endocarditis, symptomatic aortic stenosis, decompensated heart failure, disability

Applicability to Clinical Practice

The literature reviewed can offer modifications to current clinical practice guidelines in the assessment of stable angina and risk stratification of ASCVD by considering the following steps:

- Identify high-risk conditions requiring emergent invasive intervention.
- Identify major risk factors and estimate 10-year likelihood for developing a coronary event.
- ETT is recommended by current ACC/AHA guidelines for initial evaluation, but evidence demonstrated CAC scoring as an appropriate substitute in patients considered in the low to intermediate risk category, those with endurance unprovoked by exercise, and those with contraindications to ETT.
- Consider CAC score to amplify clinical judgement in risk stratification and to initiate treatment as indicated.
 - CAC=0 consider other causes of chest pain
 - CAC 1-400 medication management/consider risk and further assessment with coronary angiography
 - CAC>400 consider coronary angiography



http://www1.pwweb.com/prfiles/2012/02/07/9174141/64silicet.jpg

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