Mini Review
Volume 11:1, 2023

Journal of Cardiovascular Diseases & Diagnosis

ISSN: 2329-9517 Open Access

The Prediction, Early Diagnosis and Treatment of Cardiovascular Diseases may benefit from New Non-invasive Vascular Tests

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Abstract

Introduction: Subclinical atherosclerosis, which can be identified by elevated coronary artery calcium (CAC) or arterial stiffness as measured by the cardio-ankle vascular index (CAVI), has been linked to major adverse cardiovascular events (MACEs). Nevertheless, there are few comparable data from these two assessments of the same population.

Methods: Patients with stable coronary artery disease (CAD) who were asymptomatic or symptomatic and underwent coronary computed tomography and coronary angiography (CAVI) were enrolled and followed until December 2019 for the occurrence of MACEs (cardiovascular [CV] death, nonfatal myocardial infarction [MI], and nonfatal stroke). A cause-specific hazard model was used to look at how the CAC score related to CAVI and long-term MACEs.

Results: All in all, 8687 patients participated. The CAC scores were 0–99, 100–399, and 400 in 49.7%, 31.9%, 12.3%, and 6.1% of them, respectively. Arterial stiffness (CAVI 9.0) was linked to the severity of CAC in 23.8 percent, 36.3%, 44.5 percent, and 56.2 percent of cases, respectively. 8.0% of patients, on average 9.9, experienced MACEs. 2.4 years of follow-up (interquartile range: 7.4% to 8.6%) of the subjects. After adjusting for covariables, it was discovered that CAC scores of 100–399 and CAVI scores of 9.0 independently predicted the occurrence of MACEs, with hazard ratios (95% CI) of 1.70 (1.13–1.98), 1.87 (1.33–2.63), and 1.27 (1.06–1.52), respectively. Additional risk factors included aspirin and statin therapy, diabetes mellitus (DM), chronic kidney disease (CKD), and hypertension.

Conclusion: Patients with stable CAD who are asymptomatic or symptomatic are more likely to experience MACEs in the long run if their CAC or CAVI scores are below 9.0. These two non-invasive tests can be utilized to screen for CV events and direct treatment to prevent future ones.

Keywords: Coronary artery disease • Arterial stiffness • Predictive • Cardiovascular

Introduction

An arterial stiffness measurement derived from pulse wave velocity (PWV), the cardio-ankle vascular index (CAVI), or non-invasive imaging with a coronary CT scan can improve prediction accuracy. CAVI is a surrogate for early atherosclerosis that is independent of changes in blood pressure (BP) and is used in clinical practice more frequently than PWV. CAC scoring is an adjunctive test that improves clinical risk prediction and more accurately classifies individuals with an intermediate to high ASCVD risk or symptomatic patients with stable CAD who might benefit from primary prevention using aspirin or statins. Multiple studies confirm a strong association between CAVI and subclinical coronary artery disease. This is due to the fact that CAC scoring has been shown by the multi-ethnic study of atherosclerosis (MESA) to significantly improve classification, distinguish patients who are at risk, and assist in guiding primary prevention [1].

Literature Review

This was a review-partner study involving back-to-back patients who underwent coronary CT examinations for computer aided design evaluations at the High Level Demonstrative Imaging Community (AIMC), Ramathibodi Clinic, Mahidol College, between November 2005 and November 2013, and were followed up on until December 2019. The inclusion criteria included: adults over 18 years old; patients who were asymptomatic and had a moderate to high risk of ASCVD19, or patients who had chest symptoms that were suspicious of CAD but were clinically stable. One of the exclusions was severe asthma; a high creatinine level (greater than 1.5 mg/dl); extreme intolerance to contrast or seafood; history of coronary stenting or bypass surgery in the past The study protocol was approved by the Ethics Committee of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University (CAO) because it met the ethical guidelines of the Declaration of Helsinki from 1975. Each participant provided written informed consent prior to being enrolled in the study [2].

Each subject's age, sex, body mass index (BMI, kg/m^2), waist circumference (WC), and risk factors (such as smoking, diabetes mellitus, hypertension, and hypercholesterolemia) were all recorded. Among the laboratory results were the serum creatinine, lipid profile, and fasting plasma glucose (FPG). Having an overnight FPG of less than 126 mg/dl or taking insulin was considered to be DM. Signs of hypertension included a SBP (systolic blood pressure) of less than 140 mmHg and/or a DBP (diastolic blood pressure) of less than 90 mmHg, respectively. All forms of smoking were considered, including current smoking, quitting smoking for more than a month, and never smoking. Chronic kidney disease (CKD) was defined as an estimated glomerular filtration rate (eGFR) of 60 milliliters per minute per square meter. The eGFR was calculated using the equations from the CKD Epidemiology Collaboration (CKD-EPI) [3].

Discussion

Coronary CT Multidetector CT (MDCT) scans were carried out during the study using either a 64-slice CT scanner (Somatom Sensation 64 eco, Siemens) or a 320-slice CT scanner (Aquilion ONE, Toshiba). The two coronary CT scan results used in this analysis were the CAC score and the degree and extent of CCTA stenosis. Utilizing a financially accessible outer workstation, the Agatston strategy was utilized to compute the CAC score. The total CAC score, which was then divided into four groups based on the sum of the individual lesion scores

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Received: 02 January, 2023, Manuscript No. jcdd-23-90539; **Editor assigned:** 03 January, 2023, PreQC No. P-90539; **Reviewed:** 16 January, 2023, QC No. Q-90539; **Revised:** 21 January, 2023, Manuscript No. R-90539; **Published:** 30 January, 2023, DOI: 10.37421/2329-9517.2023.11.536

in each coronary artery: without a clearly visible plaque; mild atherosclerosis-plaque; moderate plaque with atherosclerosis; and an extensive atherosclerotic plaque weighing 400 pounds. The degree of coronary stenosis was determined by injecting 70–90 milliliters of radiocontrast (Ultravist 370 mgI/ml, Bayer Healthcare Pharmaceuticals) through the right basilic vein using an 18-gauge intravenous catheter. After that, a saline flush of 20 milliliters at a flow rate of 5 milliliters per second was carried out. Automated bolus tracking ensured that the arrival of the contrast media and the scan occurred simultaneously. Images were taken after a four-second delay during an inspiratory breath hold lasting five to ten seconds [4].

Mean standard deviation (SD) and percentage were used to summarize the baseline characteristics for continuous and categorical variables, respectively. The two test, one-way ANOVA, or quartile regression were then used to compare these across CAC score groups. The range of the MACE incidence was estimated using the 95% confidence interval (CI). In order to evaluate the connections between CAC score, CAVI, and MACEs, a cumulative incidence function (CIF) was calculated using a competing risk with sub-distribution hazard model that took into account other causes of death as competing risk events. Using a multivariate cause-specific Cox hazard (CSH) regression, the following steps were taken to determine whether CAC score, coronary stenosis, CAVI, and/or other significant risk factors were associated with a MACE (and not another cause of death as a competing risk): For a univariate analysis, the CSH model was first tailored to each risk factor. Second, compared to the univariate analysis, the multivariate CSH model simultaneously included risk factors whose p values were lower. Using backward elimination, each risk factor was removed from the model. Along with the CAC score and CAVI, the final model included only significant (p.05) risk factors. After that, estimates were made and the HR with its 95% confidence interval (CI) for each risk factor were reported [5,6].

This cohort was one of the largest ever studied, analyzing arterial calcification and arterial stiffness using the CAC score and CAVI, respectively, as risk factors for subsequent MACEs in patients with suspected stable CAD? Patients with CAC scores of 100–399 and 400 were approximately 1.70 and 1.9 times more likely than patients with CAC scores of zero to experience MACEs, respectively, according to our findings. We included both asymptomatic patients with moderate to high ASCVD risk and symptomatic stable CAD patients for the following reasons: To begin, in order to meet the needs of these patients who want to know if they have subclinical CAD, it is necessary to take into consideration the current state of the practice. After traditional risk factors like age, diabetes, hypertension, chronic kidney disease, and concurrent aspirin and statin therapy were taken into account, it was discovered that CAVIs and CAC scores were independent predictors of long-term MACEs. We also observed a dose-dependent association between calcification and arterial stiffness, despite the fact that calcification was more predictive of MACEs than arterial stiffness. CAC scores of less than 100 and CAVIs of less than 9.0 were independent risk predictors of long-term MACEs in asymptomatic patients with risk factors or symptomatic patients with suspected stable CAD [5-8].

In this investigation, the CAVI was used as a categorical variable rather than a continuous one. There may be some disagreement regarding the best incentive to separate CV risk from previous writing. Nevertheless, a CAVI 9 is generally considered to be high, indicating the presence of atherosclerosis and anticipating CV risk. CAVIs 9 were, as usual, more numerous in our patients with MACEs than CAVIs 9. Despite the fact that other confounding factors were taken into consideration, CAVIs 9 remained one of the independent risk predictors of CV events. Coronary artery disease (CAD) has been linked to both arterial stiffness and the CAC score and degree of stenosis on a coronary CT scan. In addition to supporting primary prevention, these tests are better able than ASCVD risk scores to accurately predict long-term cardiovascular events. Nevertheless, CAVI has been widely considered and utilized in several European nations and Asian nations, particularly Japan. Importantly, CAVI is vague and can be spread to older men, uncontrolled hypertension, and other conditions. It should be used to direct preventive treatment in subjects with essentially a transitional risk of computer aided design or, in theory, patients with multiple risk factors for computer aided design [9,10].

Conclusion

The CAC score and arterial stiffness as measured by CAVI can enhance risk assessment in addition to conventional risk factors alone. With CAC scores of 100 and CAVIs of 9.0, long-term MACEs were predicted for both asymptomatic patients with risk factors and symptomatic patients with suspected stable CAD. The fact that CAVI can be used as a screening tool to predict CV risk in patients with noncalcified or fibrofatty plaque is one of its advantages. However, in order to determine whether these two risk predictors improve treatment guidance, prevent subsequent CV events, or extend survival, validation is required.

Acknowledgement

None.

Conflict of Interest

None.

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How to cite this article: Chrysant, Steven. “The Prediction, Early Diagnosis and Treatment of Cardiovascular Diseases may benefit from New Non-invasive Vascular Tests.” *J Cardiovasc Dis Diagn* 11 (2023): 536.