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Framingham Risk Score and Coronary Artery Calcium Score: How Good they Relate

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Abstract

Background and Aims: Screening patients for coronary arterial disease can be through risk stratification using the Framingham Risk Score (FRS). Direct visualization of subclinical atherosclerotic lesions through coronary artery calcium scores (CACS) can be an additional strategy. Therefore, we want to know the relationship between FRS and CACS in asymptomatic individuals.

Method: A cross-sectional study involving 110 asymptomatic participants who undergoing health screening was conducted in the National Hospital, Surabaya from November 2015 until January 2016. Risk stratification was evaluated using Hard Coronary Heart Disease (10-year risk) outcomes model score and the Agatston–Janowitz's coronary calcium score.

Results: A significant positive correlation was observed between CACS and FRS (Spearman's correlation coefficient r=0.51, P<0.0001). Age and systolic blood pressure were also positively correlated with CACS. Total cholesterol was the only parameter that showed a negative correlation with CACS. No difference in CACS value was shown in gender and smoking status.

Conclusion: There was a strong correlation between FRS and CACS in asymptomatic individuals.

Keywords: Framingham Risk Score; coronary calcium score; computed tomography; coronary atherosclerosis; coronary arterial disease.

Introduction

Coronary artery disease (CAD) is known to be the biggest contributor of alldeath caused by cardiovascular disease.[1] Early detection of patient through risk stratification methodshould be the focus in daily practice in orderto prevent high-cost burden in therapy.*Framingham Risk Score* (FRS) is commonly used risk stratification algorithms and

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has been proved to provide good risk prediction.[2,3] However, FRS has not yet been able to accommodate some other important risk factors playing a role in cardiovascular events such as family disease history.

Direct visualization of the sub-clinical atherosclerotic lesions such as coronary artery calcium score (CACS) assessment has become an additional strategy suggested in patient screening. CACS was reported as better independent predictor for CAD than FRS.[4] However, most of the studies and recommendation regarding CAC focuses on Western society. In this article, we try to know the relationship between FRS and CACS in asymptomatic Indonesian individuals.

Methods

Our study was conducted in *National Hospital,* Surabaya in the period of November 2015 until January 2016 after ethical clearance was obtained. This cross-sectional study was performed to 110 asymptomatic participants for comprehensive health screening. Participants with a clinical history of angina, cardiovascular disease, and coronary revascularization were excluded. All participants voluntarily underwent medical examination and CACS screening by computed tomography (CT).

FRS was based on Hard Coronary Heart Disease (10-year risk) outcomesmodel including age, sex, smoking history, systolic blood pressure, history of taking antihypertensive medication, total cholesterol, and HDL cholesterol.[5]Blood pressure measurements were made on the left arm of the seated participants with a mercury-column sphygmomanometer and an appropriately sized cuff. Serum total and HDL cholesterol levels were determined with standardized enzymatic methods. Cigarette smoking status was ascertained by self-report. Diabetes was defined as history of physician-diagnosed diabetes and use of insulin or oral hypoglycaemic medications. Antihypertensive medication use was ascertained by the physician examiner at the heart study and based on self-report. Then, the study population was stratified into the following 5 categories according to the FRS: 0 to <10,10 to <20, and ≥ 20.

CACS was analysed from 45-65 images obtained using a 128-slice MSCT scan (GE Company).CAC was defined as a hyperattenuating lesion above a threshold of 130 Hounsfield units with an area of at least 3 adjacent pixels. It was calculated according toAgatston–Janowitz's score based on the total amount of calcific lesions from five interrogated coronary arteries (left main, left anterior descending, left circumflex, right coronary, and posterior descending).[6] For analytical purposes, we grouped the study population into the following 5 categories according toAgatston–Janowitz's score: 0, 0 to < 10, 11 to 100, 101 to 400, and >400.

The sample size was derived by calculating the correlation coefficient of 0.26 from a study by Sung, et al, 2008 and two-sided test size of 5% and statistical power of 80%.[7,8]Data were expressed as mean±standard deviation or percentages. Spearman's correlation coefficient was used to investigate the relationship between CACS and FRS. The Mann-Whitney test was used to compare risk factor status to CACS. All statistical analyses were performed using SPSS, version 20.0. A p value of <0.05 was considered statistically significant.

Results

All the 110 participants had completed the study and had no missing data. Various clinical characteristics and risk factor profiles are shown in Table 1. The majority were non-diabetic and non-smoker participants. Almost half of participants was in the low-risk category of FRS and very low-risk category of CACS. A similar proportion was obtained in group of FRS and CACS for category above intermediate risk.

Table 1: General clinical characteristics of participants (n=110)

Risk Factors	Value
Age	54.1±10.7 years
Sex (Male: Female)	56.4:43.6%
BMI	25.85±4.44 kg/m^2
Smoker	18.2%
Hypertension Medication	30.9%
SBP	132.1±19.7 mmHg
Diabetes Mellitus	9.1%
Total Cholesterol	195.1±36.3 mg/dL
HDL	48.1±12.5 mg/dL
FRS Score	14.3±13.0
0-10 (low-risk)	45.5%
>10 - <20 (intermediate-risk)	35.5%
>20 (high-risk)	19.1%

Contd... Table 1: General clinical characteristics of participants (n=110)	
CACS Score	104.8±248.3
1 = 0 (very low risk)	45.5%
2 = 0-10 (low risk)	14.5%
3 = 11-100 (intermediate risk)	17.3%
4 = 101-400 (Moderately high risk)	13.6%
5= Over 400 (High risk)	9.1%

A significant positive correlation was observed between CACS and FRS (Spearman's correlationcoefficient r=0.51, P<0.0001), as shown in Table 2. Age and systolic blood pressure were also positively correlated with CACS. Total cholesterol was the only parameter that showed a negative correlation with CACS. The BMI and HDL cholesterol were not correlated with the CACS.

Table 2: Correlation between various risk factors and CACS

Variable	Correlation Coefficient	P value
Age	0.446	0.000*
BMI	0.032	0.741
Systolic Blood Pressure	0.192	0.045*
Total Cholesterol	-0.234	0.014*
HDL	-0.175	0.067
FRS Value	0.507	0.000*
FRS Classification	0.532	0.000*

Remark: * = there is a significant relationship

As shown in table 3, no difference between male and female in terms of CACS value and CACS grading was demonstrated (p = 0.078). Smoking status also showed similar CACS. Participants who had hypertension medication or diabetes shown posed higher CACS (p=0.035 and p=0.001, respectively).

Table 3: Comparison of various risk factors and CACS

Variable	P value
Gender	0.078
Smoking	0.347
Hypertension Medication	0.037*
Diabetes Mellitus	0.001*

Remark: * = there is a significant relationship

Discussion

This study demonstrated strong correlation between FRS with CACS. The result was similar to other study in Korean population.[9] However, discrepancy between CACS and FRS in our study of population was not evaluated in our study. Furthermore, our correlation coefficient was higher than value reported by Sung, et al.[8] Zero CACS in their study was quite prevalent than our study population (70% vs 45.5%). Some studies have also suggested that CACS differs among different ethnic groups.[10]

CT usage put asymptomatic patients to cost burden, and radiation risk.[4] Therefore the benefit of usage should be greater than the risk. ACCF / AHA 2010 recommends the use of CAC ScoreMeasurement may be reasonable for cardiovascular risk assessment in low to intermediate risk patient (6% to 10% 10-year risk).[11]Otherwise, CACS of patient with low cardiovascular risk assessment (< 6% 10-year risk) cannot be treated.[12]Regardless the presence or absence of symptoms, the patient may have CAD even though he does not have an image of coronary calcification based on CT.CACS assessment along with the conventional risk stratification can improve the prediction of cardiovascular events.

In this study, age was positively correlated with CACS. Age is indeed one of the factors involved in calcification process of blood vessels either actively or passively.[13] No correlation between BMI and CACS in this study was also shown by Roy et al.[14] It reported that CACS was correlated withbody surface area (BSA) but not BMI. A reversed correlation between total cholesterol with CACS in this study may be due to the tendency ofnon-calcified plaque formation in the high cholesterol levels.[15]

No difference CACS in male compared to female group in this study. However, men tend to have a greater atherosclerotic plaque and are more calcified than women.[16]No difference CACS in smoking status group in our study may be because the smoking history was only submitted covertly. The result was similar with study by Yun-Ah Lee.[17]Diabetic participants in our study hadhigher CACS compared to non-diabetic participants. High CACS prevalence was clearly found in patients with diabetes mellitus regardless their nephropathy status.[18]

Our study did not provide the outcome data or prognosis in the population included because this was a cross-sectional study. Thefindings in our study may not be applicable to other populations withdifferent ethnic. Another limitation of our study is that thepopulation was self-referred for regular health screening. This may be a source of selectionbias.

Conclusion

In this study, there wasstrong positive correlation between FRS and CACS in asymptomatic participants. No difference of CACS value was shown in gender and smoking status.

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