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Original Research Article

Coronary Calcium Scoring and Modifiable Coronary Risk Factors

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ABSTRACT:

Introduction: Non-invasive coronary calcium scoring predicts earliest atherosclerotic changes in the coronary arteries on the basis of amount of calcium deposited in the coronary arteries. This study was done to analyze calcium scores in patients with different risk factors for coronary artery disease (CAD). **Methods**: This was a cross sectional study conducted from 1st November 2015 to 30th April 2016 at Kathmandu Medical College Teaching Hospital. Patient with cardiovascular risk factors were included in the study. These patients underwent coronary calcium scoring. Calcium scores were then compared with the presence of risk factors. **Results**: Total 467 participants were included in the study. There were 309 (62.2%) males and 158 (33.8%) females. Mean age of patient was 56.6 year (*SD* = 12.7). The difference in the scores observed with presence or absence of risk factors were statistically significant for gender, smoking, and hyper-triglyceridemia ($p < 0.05$) but not significant for impaired fasting glucose, hypertension, and body mass index. **Conclusion**: This study suggested that presence of traditional risk factors does not necessarily indicate high coronary calcium level.

Keywords: calcium • coronary angiography • coronary artery disease • ischemic heart disease • risk factors

INTRODUCTION:

Ischemic heart disease is the number one cause of death in adults from low, middle, and high income countries.[1] Standard screening tests for coronary artery disease like electrocardiography, tread mill test, and stress echocardiography are known to be normal despite the presence of atherosclerosis of the coronary arteries. Conventional coronary angiography is a gold standard for the diagnosis of coronary artery narrowing. The next equally reliable but non-invasive test is CT coronary angiography which also has the disadvantage of the use of dye during the procedure. CT coronary calcium scoring is yet another simple and non-invasive screening test for the diagnosis of coronary artery disease. This screening test also predicts earliest atherosclerotic changes in the coronary arteries on the basis of calcium scoring.[2] This study was done to analyze calcium scores in patients with different risk factors for coronary artery disease (CAD).

METHODS:

This was a cross-sectional analytical study conducted from 1st November 2015 to 30th April 2016 at Kathmandu Medical College Teaching Hospital. Approval of this study was obtained from the ethical committee of Kathmandu medical college. Consent was taken from all participants and confidentiality was maintained.

All patients of both sex aged 30 years and above with one or more coronary risk factors

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undergoing Coronary Angiography was included for the study. Patients who were not willing to give consent and having abnormal calcium metabolism like parathyroid disorders were excluded from this study.

Toshiba™ 64-slice CT scanner of Advanced Imaging Center was used for coronary calcium scoring. Agatston score was calculated. Agatston score is a semi-automated tool to calculate a score based on the extent of coronary artery calcification detected by an unenhanced low-dose CT scan which was routinely performed in patients undergoing cardiac CT. Due to an extensive body of research, it allows for an early risk stratification as patients with a high Agatston score (>160) have an increased risk for a major adverse cardiac event (MACE).[3] The scanning was done and reported by radiologist under standard condition.

The calculation was based on the weighted density score given to the highest attenuation value (HU) multiplied by area of the calcification speck. Weighted density score for highest attenuation value was graded as:

130-199 HU: 1
200-299 HU: 2
300-399 HU: 3
≥ 400 HU : 4

Study variables were: Age, sex, weight in Kg, height in cm, and Body Mass Index (BMI) in Kg/m^2. Coronary artery risk factors considered were: Hypertension (> 140/90 mmHg), impaired fasting blood glucose (IFG > 100mg/dl), Smoking(> 100 cigarettes/year), hyper-triglyceridemia (triglyceride > 150 mg/dl), and BMI > 25 kg/m^2 as in study done by Nadeem M. et al.[4]

Univariate analysis was done to see the relationship between independent variables and outcome variable. The outcome variable was a low (up to 160) or a high (> 160) Agatston score. Statistical package for Social Science (SPSS-16) was used for data entry. Range, mean, and standard deviation were computed to describe the characteristics of data. Continuous variables were expressed as mean and standard deviation, and categorical baseline data were used in number and percentage. *Chi-square* test was used to analyze relationship between categorical data. *P* value less than 0.05 was considered as significant.

RESULTS:

Total 467 participants were included in the study. Forty nine (10.5%) patient had Agatston score more than 160. There were 309 (62.2%) male and 158 (33.8%) female. Mean age of patients was 56.6 year (*SD* = 12.7). One hundred thirty four (28.7%) were smoker, 149 (31.9%) said that they take alcohol, 343(73.4%) had hypertension, and 73 (15.6%) had history of CAD.

Table-1 shows frequency of different variables with categories of Agatston score. It also shows the statistical values which reveal that the relationship of categories of Agatston value was statistically significant with gender, smoking habit, and hyper-triglyceridemia. Male and smoker each had a significantly higher probability of having score > 160 whereas participants with high triglycerides were more likely to have low Agatston score.

Table 1: *Relationship between Agatston score category and different parameters (N = 467)*

Variables		Agatston score < 160 *n* (%)	Agatston score ≥ 160 *n* (%)	Statistics
Gender	Male	269 (87.7)	40 (12.3)	X^2=5.8, *df*=1, *p*=0.02
	Female	149 (94.3)	9 (5.7)	
Smoking	Smoker	108 (80.6)	26 (19.4)	X^2=15.8, *df*=1, *p*<0.001
	Non Smoker	310(92.8)	23 (7.2)	
IFG*	Yes	122 (86.5)	19 (13.5)	X^2=1.9, *df*=1, *p*=0.17
	No	296 (90.8)	30 (9.2)	
Hyper-tension	Yes	309 (90.4)	34 (9.6)	X^2=0.4, *df*=1, *p*=0.4
	No	109 (87.9)	15 (12.1)	
BMI#	Under-weight	3 (60)	2 (40)	*p*=0.06 Fisher Exact
	Normal	189 (87.1)	28 (12.9)	
	Over-weight	171 (92.4)	14 (7.6)	
	Obesity	55 (91.7)	5 (8.3)	
Tri-glycerides	Normal	290 (87.9)	40 (12.1)	X^2=5.3, *df*=1, *p*=0.02
	Increased	130 (94.9)	7 (5.1)	

* Impaired Fasting Glucose; # Body Mass Index

Table-2 shows relationship between categories of Agatston score and participants having either both impaired fasting glucose and hypertension or only one of the two. It reveals that participants having both impaired fasting glucose and

Table 2: Agatston score category in patients with either both diabetes and hypertension or only one of those condition (N = 363)

Risk factors	Agatston score < 160	Agatston score > 160	Statistics
IFG* or HTN#	265 (84.4%)	49 (15.6%)	X^2=14.9, df=1, p<0.001
IFG and HTN	30 (61.2%)	19 (38.8%)	

* Impaired Fasting Glucose; # Hypertension

hypertension have significantly higher probability of having high Agatston score (> 160).

DISCUSSION:

This study showed that coronary calcium scoring was significantly higher in male (p = 0.02) and smokers (p = <0.001). This suggests that male and smoking, which is traditionally considered as one of the risk factor for acute coronary syndrome, can be expected to have high Agatston score. The significance was also observed with Triglyceride (p = 0.02). However patients with hyper-triglyceridemia were more likely to have a low Agatston score. This finding might have been affected by confounding factors. Multivariate analysis and a larger sample size can be recommended to further explore this relationship.

This study does not show relationship of Agatston score with other risk factors. Similarly, significantly higher proportion of patients with both IFG and hypertension had higher Agatston score as compared to those with only one of those co-morbidity (p < 0.001). Coronary calcium scoring has been found to correlate well with plaque burden but not with angiographic luminal narrowing.[5] Eighteen percentage of subjects without coronary risk factors have been found to have coronary plaque.[6] No association has been found between the degree of stenosis and plaque composition or vulnerability.[7] Thus, all of the coronary risk factors included in our study do not essentially state the plaque burden. This study has generated hypothesis that coronary calcium scoring is independent of the coronary risk factor and may not have relationship with plaque or stenosis. Having diabetes or hypertension alone also does not necessarily indicate Agatston score as a high risk for coronary artery disease as compared to those having both of them. So, hypertension, diabetes and coronary calcium might be independent risk factor.

According to WHO estimates, 16.6 million people died of cardiovascular diseases (CVD) in 2001 and developing countries contributed to 78%. About 3.8 million men and 3.4 million women worldwide die each year from coronary artery disease.[8] WHO estimates that nearly 25 million people are expected to die of CVD by 2020.[9] The incidence of coronary artery disease is declining in the developed countries. On the other hand it is increasing in the developing world. There are a very few studies about the prevalence of coronary artery disease in Nepal. A population study at Dharan municipality performed by Vaidya A. et al. revealed the prevalence of coronary artery disease to be 5.7% in adult males of eastern Nepal.[10] So, it is important to find a way to screen coronary heart disease. Traditional risk factors has been an important tool to screen this condition.

There are other standard screening tests for coronary artery disease like electrocardiography, tread mill test, and stress echocardiography. These tests are known to be normal despite the presence of atherosclerosis of the coronary arteries. Conventional coronary angiography is a gold standard for the diagnosis of coronary artery narrowing but it has a disadvantage of being an invasive procedure with a life threatening complication rate of one per thousand.[11] A study suggested that calcium scores can be used to stratify risk factor in asymptomatic patient and is a strong predictor of predictive information beyond the traditional risk factors in different ethnic group.[2] However, in this study having risk factors did not increase calcium score in most cases so it may be hypothesized that coronary calcium score and traditional risk factors might be independent risk factors.

Limitation of the study:

The study has not considered confounding factors like duration and stages of risk factors; change in the nature of disease following medication and significant cardiovascular events in the past. The study has not included all traditional risk factors.

CONCLUSION:

This study generates an important hypothesis that all traditional risk factors does not necessarily indicate coronary calcium at the level which is the risk for coronary artery disease. Higher study is suggested to confirm this finding.

Conflict of Interest: None declared

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