Estimation of coronary artery calcium by multislice spiral CT scan in asymptomatic high risk cases above forty (40) years of age

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Abstract

Hypertension, diabetes mellitus, smoking, obesity and family history of coronary artery disease are among known risk factors of coronary artery disease. Computed tomography (CT) quantifies the relative burden of CAC deposits as a marker of atherosclerosis.

Methodology: This was a case control study conducted at Indira Gandhi Medical College and Hospital, Nagpur from June 2004 to June 2006, with aim to find out the utility of multislice spiral computed tomographic (CT) scan for detection of coronary artery calcium in asymptomatic coronary high risk cases and attempts has been made to correlate CAC Score with various risk factors and has been compared with CAC Score of controls

Results: The maximum numbers of cases were in group of 41-50 years (n=31, 53.4%). The male to female ratio was 1.52:1. Among the risk factors studied, dyslipidemia (65.5%) was most common risk factor. Mean CAC score of all cases was significantly higher than, mean CAC score of all controls (p value= 0.0004). There was a progressive increase in the mean CAC score with increasing age. When all the risk factors were individually compared with controls, all showed higher CAC score and all the differences were statistically highly significant.

Conclusion: Coronary artery calcium increases with increasing age and male sex. It also increases with presence of major risk factors for coronary artery disease (CAD). Hence, multislice spiral CT scan, being a non-invasive test can be recommended as a screening test for demonstrating significant atherosclerosis in susceptible subjects even when asymptomatic.

Keywords: Coronary artery diseases, Coronary artery calcium, Ct scan risk factors

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Introduction

Coronary artery disease (CAD) accounts for approximately 12 million deaths annually and is the commonest cause of deaths globally. Hypertension, diabetes mellitus, smoking, obesity and family history of coronary artery disease are among known risk factors. Prospective epidemiological studies have established the association between major risk factors and the development of clinical CAD. However, it has been estimated that these risk factors fail to explain up to 50% of CAD mortality and morbidity.(1) Strong relationship have been demonstrated between the presence of occlusive CAD and coronary artery calcification (CAC) detected at autopsy, fluoroscopy and computed tomography.(2)

Given the scope of global illness burden due to cardiovascular disease, there is a need for new strategies for the primary prevention of CAD.(3) Computed tomography (CT) provides exquisite, high resolution imaging of the body and also the heart (and vascular system in general). It quantifies the relative burden of CAC deposits as a marker of atherosclerosis. It is also sensitive for the detection of significant angiographic disease and allows for rapid image acquisition, reduction of cardiac motion artifacts and high-contrast resolution.

Materials and Methods

This was a case control study conducted at Indira Gandhi Medical College and Hospital, Nagpur during period from June 2004 to June 2006. Study was initiated after approval of institutional ethical committee. This study has been undertaken to find out the

utility of multislice spiral computed tomographic (CT) scan for detection of coronary artery calcium in asymptomatic coronary high risk cases and attempts has been made to correlate CAC Score with various risk factors and has been compared with CAC Score of controls (having no coronary risk factor). All asymptomatic individuals of more than forty years who consented and had any of risk factors like systemic hypertension, diabetes mellitus, dyslipidemia, smoking, obesity and family history of coronary artery disease. Individuals having previous myocardial infarction or valvular heart disease or pregnancy were excluded from the study. Age and gender matched individuals who consented for study and who had none of the above mentioned risk factor were selected as controls. All the patients were scanned on Siemen's multislice computed tomography, Somatom volume access. The study protocol included obtaining a topogram and axial images and post processing of axial images. Total scores were obtained for each of the following major coronary arteries (a) left main (b) left anterior descending (c) left circumflex and (d) right coronary artery. Coronary calcifications were quantified using the Agatston score. Four absolute coronary score (CS) were considered: Normal (CS=0), mild score (CS = 1 –100), moderate score (CS = 101- 400) and severe score (CS>400). Score of cases were compared with controls. Statistical test used in analysis included 't' test and 'chi square' test. All p values were two tailed and values <0.05 were considered statistically significant. Results were compared with national and international studies.

Results

Fifty-eight (58) asymptomatic coronary high risk cases and Fifty eight (58) age and gender matched individuals not having any of the mentioned risk factors were included as controls in the study. The maximum numbers of cases were in group of 41-50 years (n=31, 53.4%). **(Table 1)** The male to female ratio was 1.52:1. Among the risk factors studied, dyslipidemia (65.5%) was most common risk factor. **(Table 2)** Mean CAC score of all cases was significantly higher than, mean CAC score of all controls.(p value= 0.0004). There was a progressive increase in the mean CAC score with increasing age. **(Table 3)** When all the risk factors were individually compared with controls i.e. having no risk factor, all showed higher CAC score and all the differences were statistically highly significant. **(Table 4)** When cases were studied for every single risk factor against all other remaining risk factors, it was found that mean CAC score was higher in cases that were having hypertension, smoking or family history of CAD. **(Table 5)**

Table 1: **Age and Sex distribution of cases & controls**

Age group (in years)	Cases (N= 58)		Controls(N=58)	
	Male (N=35)	Female (N=23)	Male (N=35)	Female (N=23)
41– 50 (N=31)	16 (45.7%)	15 (65.3%)	16 (45.7%)	15 (65.3%)
51 – 60 (N=17)	11 (31.4%)	6 (26%)	11 (31.4%)	6 (26%)
>61 (N=10)	8(22.9%)	2 (8.7%)	8(22.9%)	2 (8.7%)

Table 2: **Patient-Risk factor demographics (N=58)**

Sr. No.	Risk Factor	Relation
1.	Mean age(years)	52.31+ 9.70
2.	Sex ratio male : female	1.52 : 1
3.	Dyslipidaemia	38 (65.5%)
4.	Hypertension	30 (51.7%)
5.	Diabetes mellitus	30 (51.7%)
6.	Smoking	20 (34.4%)
7.	Family H/o CAD	13 (22.4%)
8.	Obesity (BMI >30)	7 (12%)

Table 3: Correlation of total coronary artery calcium (CAC) with age in cases and controls

Age group in years	Cases		Controls	
	Range	Mean CAC+SD	Range	Mean CAC+SD
41 – 50 (n=31)	0 – 239	34.44+73.34	0 – 0.9	0.09+0.25
51 – 60 (n=17)	0 – 548	79.42+147.51	0 – 9.6	0.6+2.4
>61 (n=10)	0 – 579.6	90.68+196.22	0 – 0.6	0.06+0.18
(Total, n=58)	0 – 579.6	57.32+125.08	0 – 9.6	0.221.26

Table 4: Comparison of CAC scores of cases having risk factors with that of controls

Risk factors	Mean CAC score±SD	Controls	Mean CAC score±SD	P value
Hypertension (n=30)	78.86±129.74	n=58	0.22±1.26	<0.0001
Diabetes mellitus (n=30)	41.60±112.56			0.0030
Dyslipidemia (n=38)	49.13±111.11			0.0006
Smoking (n=20)	119.29±179.78			<0.0001
Family history of CAD (n=13)	151.24±173.47			<0.0001
Obesity (n=7)	52.44±97.80			<0.0001

Table 5: Correlation of Mean total CAC score of individual risk factor with other risk factors

Risk factors	Status	Mean CAC + SD	P value
Hypertension	Present (n=30)	78.86+129.74	0.08
	Absent (n=28)	34.24+117.81	
Diabetes mellitus	Present (n=30)	41.60+112.56	0.83
	Absent (n=28)	74.16+137.29	
Dyslipidemia	Present (n=38)	49.13+111.11	0.75
	Absent (n=20)	72.88+150.01	
Smoking	Present (n=20)	119.29+179.78	0.002
	Absent (n=38)	24.70+65.55	
Family history of CAD	Present (n=13)	151.24+173.47	0.0008
	Absent (n=45)	30.19+93.27	
Obesity	Present (n=7)	52.44+97.80	0.54
	Absent (n=51)	57.99+129.16	

Discussion

In the recent years, the incidence of acute myocardial infarction (AMI) has continued to increase even through the mortality rate from AMI has declined. Hence primary prevention of coronary artery disease (CAD) must remain the focus of public health policies.(4) Quantification of calcium in coronary arteries has been shown to reflect the total atherosclerotic plaque burden, and it can be detected by using advance high speed CT scan including spiral CT scan. According to Haberl,[5] 55% asymptomatic men and women <40 years of age had no coronary calcium. Therefore, chances of detecting significant calcium in cases below 40 years were less. Hence, in the present study, cases above 40 years of age were included. Mean age of cases was 52.31 years, which was consistent with findings of Raggi et al[4] (mean age 53 years) and Tanenbaun SR et al[6] (mean age 54 years). Maximum cases in present study were between 41-50 years of age which is consistent with the study of Agatston AS et al.[7] Goel M et al[8] and Haberl et al[5] had maximum number of cases in older age group as compared to the present study.

In the present study, most frequently observed risk factors were dyslipidaemia (65.5%), hypertension (51.7%), diabetes mellitus(51.7%), and smoking (34.4%) Wong ND et al[9] observed diabetes mellitus only in 8% cases as compared to 51.7% cases in the present study. Schmermund et al.[10] observed family H/0 CAD as the most common risk factor, while Raggi et al[4] observed more

smokers(65%) as compared to the present study(34.4%).

In the present study the number of cases having 1, 2 and ≥3 risk risk factors were 32.8%, 37.9% and 29.3% respectively. Arad Y et al[11] observed 7%, 23%, 36%, 26%, 6% and 2% cases having 0, 1, 2, 3, 4 and 5 risk factors respectively. In the present study, it was observed that as the no. of risk factors increased, mean CAC score had also increased. Mean CAC score was significantly higher in cases with ≥3 risk factors as compared with 2 risk factors (p value = 0.03) and 1 risk factor (p value = 0.007). Goel M et al[8] also observed similar findings (p value<0.01). However, their CAC scores were more as compared to our study and the reason may be the western population in study with more sedentary life style and cases with more mean age in their study.

It was observed by many workers like Janowitz WR et al,[12] Wong et al,[13] Arad Y et al[11] and Raggi P et al[4] that CAC increase as age advances. There was a progressive increase in mean total CAC score with increasing age in the present study in cases but the differences were not statistically significant. However in controls, there was no such correlation between CAC score and age. This might be due to small sample size. Goel et al[8] observed progressive increase in CAC score with increasing age and also CAC scores were quantitively more in their study as compared to the present study and the differences were statistically significant. This may be due to a large sample size in their study (N=597) as compared to a small sample size in present study (N=58)

In the present study, mean total CAC scores were higher in cases with smoking, family H/O CAD and hypertension. But the differences were statistically significant only for smoking (p value= 0.002) and family H/O CAD (p values =0.0008). The insignificant difference in groups of other risk factors may be due to wide dispersion of CAC score and small sample size. Goel M et al[8] observed significant increase in CAC score for smoking, dyslipidemia but not for hypertension. Shrivastava et al[14] reported significantly higher prevalence of detectable calcium in cases with obesity. Arad Y et al[11] observed positive correlation of CAC score with dystipidemia (p=0.007), hypertension (P<0.0001), smoking (P<0.0001), diabetes mellitus(p<0.0001)but not with family H/O CAD (p=0.46) which is contrary to present study. Schmermund A et al[10] found strong correlation of mean CAC score with dyslipidermia, diabetes mellitus, smoking and weak correlation was found with age and family H/O CAD.

Conclusion

The present study demonstrated that multislice spiral CT is a useful technique for detection of coronary artery calcium (CAC). Coronary artery calcium is present in most cases that have coronary risk factors. Coronary artery calcium increases with increasing age and male sex. It also increases with presence of major risk factors for coronary artery disease (CAD). Hence, multislice spiral CT scan, being a non-invasive test can be recommended as a screening test for demonstrating significant atherosclerosis in susceptible subjects even when asymptomatic.

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