

Coronary CT Angiography in Asymptomatic Diabetes Mellitus.

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ABSTRACT

Background: Coronary artery disease is often asymptomatic in diabetic patients until the onset of myocardial infarction or sudden cardiac death. Coronary artery CT angiography can detect Coronary artery disease with high specificity and sensitivity. Aims & objectives: To evaluate the prevalence of coronary artery disease by CT angiography in type 2 diabetes mellitus patients asymptomatic for coronary artery disease with one or more additive risk factors for coronary artery disease. **Methods:** This hospital based observational study was conducted from March 2013 to August 2014 at GMC Srinagar. This study was carried out among Type 2 diabetes mellitus patients asymptomatic for coronary artery disease with one or more additional risk factors for coronary artery disease. Total of 52 patients with Type 2 diabetes patient underwent Cardiac CT. **Results:** Mean age of study population was 57.08 ±9.33 years..34 were males and 18 were females. 65.39% of total patient who underwent CT Angiography had plaque in coronary arteries while 34.61% have no plaque and normal coronary vessels. 19.23% patients have significant stenosis defined by luminal narrowing more than 70%. There was statistically significant relation between those who have patient significant stenosis and non-significant stenosis with regards to mean age, BMI, duration of diabetes, HDL, LDL, total cholesterol, TG, HbA1c and coronary calcium score. **Conclusion:** Asymptomatic diabetics with additional risk factors have high prevalence of atherosclerotic plaques with 19% having obstructive CAD. The timely detection of CAD can help in optimizing treatment.

Keywords: Coronary artery disease(CAD), asymptomatic diabetics, CT Coronary angio.

INTRODUCTION

The global prevalence of diabetes mellitus (DM) in 2014 was estimated to be 8.3% in adult aged 25 years and more.^[1] The true prevalence of diabetes in Kashmir is unknown however it is estimated that 1.87% (1.89 in males and 1.77 in females) have diagnosed diabetes while 4.25% have undiagnosed diabetes and 8.08% have impaired glucose tolerance test, making total load of abnormal glucose tolerance 14.23% in Kashmir.^[2] Diabetes is an important risk factor for development of coronary artery disease.^[3]

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Coronary artery disease is the single most common cause of death in American men and women^[4] after

decades of decline in coronary artery disease death rate the incidence of acute coronary syndrome has continued to rise in united states^[5] moreover approximately 21% of first and recurrent annual myocardial infarctions are silent.^[6]

The overall prevalence of coronary artery disease in Jammu & Kashmir population studied by all diagnostic measures was 7.54% with rural of 6.7% and urban of 8.37% prevalence was higher in males, 7.80% than in females 6.63%.^[7] Diabetics have great burden of atherogenic risk factors than Non diabetics including obesity, hypertension, lipid abnormalities, insulin resistance and elevated plasma fibrinogen.^[8-10] Moreover, in diabetes whenever coronary artery disease is present it is in advance stage with greater extend of coronary artery involvement hence morbidity and mortality are much higher than without diabetes.^[11] Patients with diabetes are known to have silent ischemia more often than those without diabetes mellitus (DM).^[12-14] Another component of decrease in angina perception is that diabetic patients have

prolongation of angina perceptual threshold during exercise testing that is time from onset of ischemic changes on electrocardiogram to onset of angina.^[15] The longer the threshold, greater the exercise capacity and more severe the ischemia. The multi-vessel coronary artery disease is also common in asymptomatic patients with type 2 diabetes mellitus (DM), particularly those with two or more coronary risk factors other than diabetes; hence, a strategy for early screening and treatment will considerably reduce the mortality and morbidity associated with coronary artery disease in asymptomatic diabetics. Coronary artery disease is often asymptomatic in diabetic patients until the onset of myocardial infarction or sudden cardiac death.^[16] As a consequence diabetic patients have more extensive coronary atherosclerosis and their epicardial vessels are less amenable to intervention treatment compared with the non-diabetic population.^[17-19] Furthermore asymptomatic patients may have coronary anatomy that does not permit optimal outcome with PCI or CABG. This is more likely to occur in patients with two or more other cardiovascular risk factors.^[20] This had led to increased emphasis on primary prevention of arteriosclerotic cardiovascular disease in diabetics. Different tests cannot predict accurately who are the diabetic patients who will develop a coronary event, thus American College of Cardiology (ACC) /American Diabetic Association (ADA) recommends that cardiac testing to be done irrespective of presence of coronary artery disease symptoms in diabetics with two or more risk factors.^[21] Coronary angiography though regarded as the golden standard for evaluation of CAD but is invasive & it cannot depict the type of plaque. However multi detector CT (MDCT) angiography can accurately determine plaque composition and assess degree of luminal narrowing in addition it also gives information regards condition of vessel wall and plaque burden by detecting plaques with positive remodeling. The coronary artery CT angiography (CACT) allows a quick non-invasive imaging for coronary artery disease at an early stage. CAD should be ruled out in patients with low to intermediate risk for coronary artery disease this is especially helpful in patients who are unable to undergo invasive coronary angiography or who are at risk for the procedure.^[22] In asymptomatic diabetics Coronary artery CT angiography can detect stenosis with high specificity and sensitivity. The scanning time to acquire a three-dimensional dataset of the entire heart can take as little as 5 seconds. The diagnostic accuracy of multi-slice computed tomography angiography is similar in diabetic and non-diabetic individuals.^[23] Importantly negative predictive value of multi-slice computed tomography angiography in diabetes was to be found 98%-100%.^[24] Thus, results on the use of non-invasive multi-slice computed tomography

angiography for coronary heart disease screening and as a prognostic indicator in the diabetic population appear promising but further studies in larger population groups are needed. Multi-slice computed tomography angiography has good sensitivity, specificity and negative predictive value for identification of coronary heart disease in diabetic patients.

Aims & Objectives:

To evaluate the prevalence of coronary artery disease by CT angiography in type 2 diabetes mellitus patients asymptomatic for coronary artery disease with one or more additive risk factors for coronary artery disease.

MATERIALS AND METHODS

This hospital based observational study was conducted from March 2013 to August 2014 at GMC Srinagar. This study was carried out among Type 2 diabetes mellitus patients asymptomatic for coronary artery disease with one or more additional risk factors for coronary artery disease.

Inclusion Criteria

1. Type 2 diabetes mellitus
2. Age more than 40 years
3. Normal kidney function test

Exclusion criteria

1. Angina pectoris or its equivalent.
2. History of myocardial infarction, heart failure or percutaneous coronary intervention or coronary bypass craft surgery.
3. ECG showing evidences of old Q wave infarcts, LBBB or ST-T wave changes.
4. Significant arrhythmias.
5. Hepatic failure.
6. Allergy to x-ray contrast media.

Total of 52 patients with Type 2 diabetes were taken for study. In all selected patient Cardiac CT was performed on 128 slice (Siemens Somatom Definition AS/AS+ with fast care scanner), using prospective ECG gating. Premedication in form of 50 mg or 100 mg metoprolol were administered based on body mass and basal heart rate to maintain stability of cardiac rhythm (heart rate less than 70) for patient who demonstrates heart rate variability one hour before the study. A low dose, non-contrast calcium scoring examination was done in all the patients before coronary CT is done. After adequate intra venous access, a coronary CT angiography scan was performed, beginning at 2cm above the most superior point in left anterior descending cardiac artery and extending 1-2 cm below the cardiac apex. The subjects were instructed to maintain an inspiratory breath-hold

during which CT data and ECG trace were acquired. Left and right coronary arteries were divided into 15 segments and plaques were classified as calcified plaque (plaques with higher CT density than contrast enhancing lumen, Non calcified plaques (plaques with lower CT attenuation than contrast enhanced lumen without any calcification and mixed type consisting of calcified and non-calcified). subject without coronary plaques were considered normal. CACT angiography was carefully examined for evidences of early signs of coronary artery disease (CAD) defined as presence of athermanous plaques in coronary which could be clearly distinguish from the vessel lumen, with or without luminal reduction and significant coronary artery disease (defined as stenosis of more than 70% in coronary artery lumen).

RESULTS

A total of 52 diabetic individuals who were asymptomatic for CAD were studied. Mean age of study population was 57.08 ± 9.33 years which ranges from 40 to 80 years. 34 were males and 18 were females. Our study consists of both rural and urban population. 55.8% of study population was rural and 44.2% were urban residents. Mean body mass index of study population was 27.51 ± 2.867 which ranged from 18 normal BMI to morbid obesity with BMI more than 30. In our study population 32.7% both male as well as female have current smoking history while 67.3% have no history of current smoking. our study population 82.7% both male and female were hypertensive while as 17.3% were normotensive. In our study family history of heart disease in form of heart disease in blood relation at early age 55 year in male relative and 65 year in female relative was present in 13.5%. This study consists of diabetic diagnosed first time to those who have diabetes from more than 15 year. Mean duration of diabetes of study group was 6.18 ± 3.209 years.

Table 1: Lipid & Glycemic profile of patients

Biochemical parameter	Mean	SD
LDL	125.5	11.3
HDL	46	4.67
TC	184	14.5
TG	172.5	14.57
HBA1C	7.1	1.04
BUN	12.9	3.5
Creat	1.1	0.2
BS(F)	157	18.7

In 52 diabetic patients who were enrolled in study mostly 75% were on oral hypoglycemia agents, 5.77% were on insulin and 11.53% were on combination of insulin and oral hypoglycemia agents and only 7.65% were dietary and life style

management for diabetes. Various biochemical parameter of lipid profile and glycemic control shown in [Table 1].

Non-contrast calcium scoring examination showed coronary artery calcium score of zero in 28.8% of subject 0.1-100 in 51.9% 100 -400 in 11.5% and more than 400 in 7.7% of study population. In our study we found that mean coronary artery score (CACS) was 74.8 ± 127.7 angstrom units with range from 0 to >400. On cardiac CT angiography 65.39% of total patient who underwent CT Angiography had plaque in coronary arteries while 34.61% have no plaque and normal coronary vessels. Total of 92 plaques were present in 34 diabetic patient out of 52 patient who underwent CT angiography and out of 92 plaques 33.7% were calcified 19.6% were non calcified while most of plaques 46.7% were mixed type. After analysis of CT angiography 19.23% patient have significant stenosis defined by luminal narrowing more than 70% and 34.61% of patient are disease free i.e. normal lumen and 46.15% have luminal stenosis less than 70%. Left anterior descending artery was most commonly involved in patient who had significant stenosis (66.66%) while right circumflex was involved in 33.33% of patients. Single vessel was involved in most of patient with significant stenosis in 80% while in 20% two vessel were involved. <0.001. There is also statistically significant relation of coronary calcium score and age p value 0.001. There was statistically significant relation between those who had athermanous plaques in coronary vessels and those who have no plaques with respect to body mass index, duration of diabetes, HDL and highly significant with CACS as shown in [Table 2]. There was statistically significant relation between those who have patient significant stenosis and non-significant stenosis with regards to mean age, BMI, duration of diabetes, HDL, LDL, total cholesterol, TG, HbA1c and coronary calcium score, there is also statistically significant relation of stenosis and prevalence of coronary artery plaques with higher coronary artery calcium score as shown in [Table 3].

DISCUSSION

Our study, which was cross sectional conducted from March 2013 to August 2014. A total of 52 patients with history of Type 2 diabetes mellitus asymptomatic for coronary disease, with one or more additive risk factors for coronary artery disease attending SMHS hospital OPD were included.

Table 2: Showing factors associated with coronary artery plaques

Variable	CORONARY ARTERY PLAQUES				P-value
	Plaques present (n=34)		Plaques Absent (n=18)		
	Mean	SD	Mean	SD	
Age	58.4	8.79	54.6	10.08	0.168 (SNSD)
BMI	28.2	2.42	26.3	3.28	0.022 (SSD)
Duration of Diabetes	6.5	2.98	5.5	3.60	0.057 (SSD)
LDL	127.4	12.94	122.0	6.15	0.102 (SNSD)
HDL	45.1	5.23	47.7	2.72	0.05 (SSD)
TC	186.3	15.02	180.3	13.10	0.157 (SNSD)
TG	173.8	16.48	170.1	10.03	0.395 (SNSD)
HbA1C	7.3	1.13	6.8	0.81	0.164 (SNSD)
CACS	113.2	144.33	2.4	6.88	0.002 (SSD)

Table 3: Showing factors associated with obstructive CAD

Variable	Significant Stenosis (n=10)		Non-significant Stenosis (n=42)		P-value
	Mean	SD	Mean	SD	
Age	64.6	5.78	55.3	9.16	0.004 (SSD)
BMI	29.8	1.72	27.0	2.83	0.039 (SSD)
Duration of diabetes	8.4	3.08	5.7	3.05	0.016 (SSD)
LDL	144.0	8.01	121.1	6.43	<0.001 (SSD)
HDL	37.9	2.27	47.9	2.51	<0.001 (SSD)
TC	205.0	6.88	179.3	11.08	<0.001 (SSD)
TG	194.7	8.37	167.3	10.06	<0.001 (SSD)
HbA1C	8.0	1.46	6.9	0.81	0.002 (SSD)
CACS	298.6	140.99	21.6	28.69	<0.001 (SSD)

Ten patients (19.86%) were having significant CAD defined by luminal narrowing $\geq 70\%$. 46.1% of patients had non-significant luminal narrowing < 70%. Of patients with significant luminal narrowing 80% had involvement of single vessel while 20% have double vessel, and none had triple vessel involvement .66.66% have left anterior descending artery involvement, 33% have right circumflex artery involvement, non-have left main and left circumflex artery involvement.

There was statistically significant relation between those who had coronary artery plaques and those who were plaque free with respect to with respect to body mass index ($p=0.02$), Duration of diabetes ($p=0.057$), HDL ($P=0.05$) CACS($P=0.002$). There was statistically significant relation between those significant stenosis and non-significant stenosis with regards to mean age ($P 0.004$) BMI ($P 0.039$)

duration of diabetes ($P 0.016$) HDL ($P<0.001$) LDL ($P < 0.001$) total cholesterol ($P =0.001$), TG ($P <0.001$) HbA1c ($P= 0.002$) coronary calcium score ($P <0.001$).

The mean age in our study was 57.8 ± 9.33 & was comparable with studies ^[25-30]. 65% of patient in our study were male which was comparable with other studies.^[25,26,27,29] Average BMI in our study was 27.51 ± 2.86 & showed significant relationship between high BMI with CACS, Coronary artery disease & significant stenosis. BMI was comparable with other studies. Average duration of diabetes was 6.18 ± 3.2 years in our study comparable to other studies.^[25,27] Family history of coronary heart disease was present in 13.5% of population .Most of our patients were hypertensive in our study (82.7%) comparable to other studies.^[26,29] 32.7% of patients were smokers.

Coronary artery plaques on cardiac CT Angiography was in 65.39 % of study population in our study comparable with other studies [25,26] however some studies [30] have shown plaques were present in 90% of patients. The patients in these studies had higher age and BMI as compared to our study. Significant stenosis was present in 19.3% of the patients in our study which is in conformity with other studies.^[27-29,31]

Our study demonstrates the value of screening diabetic patients with one or more risk additive risk factors for CAD as 19 % of our population had significant CAD (coronary narrowing > 70%). Diabetic individuals have higher risk of developing CAD at an earlier age. The first presentation of CAD in diabetics can be a fatal MI, hence the need for screening individuals with diabetes with additive risk factors cannot be over emphasized. However on the other hand there is no published data, which has shown that a prospectively applied screening program has improved outcome in asymptomatic diabetic patients.

CONCLUSION

Asymptomatic diabetics with additional risk factors have high prevalence of atherosclerotic plaques with 19% having obstructive CAD. The timely detection of CAD can help in optimizing treatment. Coronary CT angio is cost effective, safe and non-invasive method of identifying CAD in asymptomatic diabetics with additional risk factors.

REFERENCES

1. International diabetes federation.
2. Zargar AH, Khan AK et al. prevalence of type 2 diabetes mellitus and impaired glucose tolerance in Kashmir valley of Indian subcontinent. *Diabetes res clinpract.* 2000; 47(2):135-46
3. Kannel WB, McGee DL et al. diabetes and glucose tolerance as risk factors for cardiovascular disease: the Framingham study. *Care .diabetes,* 1979; 2 (2):120-126.
4. National center for health statics ,center for disease control and prevention, compressed mortality file, underlying causes of deaths 1979 -2005 Atlanta ga; central for disease control and prevention. available at <http://wonder.cdc.gov/mortsql.html> assessed may 29 2008
5. Lloyd-jones D, Adams R, et al. American heart association statistics committee and stroke heart disease and stroke statistics 2009 update: a report from the American heart association statistics committee and stroke statistics subcommittee. *Circulation.* 2009; 119(3): e21-181. Doi: 10.1161/circulationaha.108.191 261.
6. Boland LL, Folsam AR et al. Occurrence of unrecognized myocardial infarction in subject aged 45-65. *The ARCI study am j cardiol.* 2002;92: 90,7-31
7. Kamili M, Dar Iqbal, Ali G, Wazir H et al. Prevalence of coronary artery disease in Kashmir Indian heart j. 2007; 59-16: 44 -9.
8. Mueller HS, Cohen LS, Braunwald E et al. Predictors of early morbidity and mortality after thrombolytic therapy of acute myocardial infarction. Analyses of patient subgroups in the thrombolysis in myocardial infarction (TIMI) trial, phase ii. *Circulation.* 1992; 85: 1254.
9. Abaci A, Oğuzhana, Kahramans et al. Effect of diabetes mellitus on formation of coronary collateral vessels. *Circulation.* 1999; 99:2239.
10. Anand DV, Lim E, Lahiria et al. The role of non-invasive imaging in the risk stratification of asymptomatic diabetic subjects .*Eur heart j.* 2006; 27:905.
11. Grundy SM, Benjamin IJ et al. Diabetes and cardiovascular disease: a statement for healthcare professionals from the american heart association. *Circulation.* 1999; 100:1134.
12. Guk, Cowiecc, Harris MI et al. Diabetes and decline in heart disease mortality in us adults. *Jama.* 1999; 281:1291.
13. Juutilainenena, Lehtos, Rönneemaat et al. Type 2 diabetes as a coronary heart disease equivalent: an 18-year prospective population-based study in finnish subjects. *Diabetes care.* 2005; 28:2901.
14. Hu G, Jousilahtip, Qiaoq et al. The gender-specific impact of diabetes and myocardial infarction at baseline and during follow-up on mortality from all causes and coronary heart disease. *Jam collcardiol.* 2005; 45:1413.
15. Ranjadayalan k, Umachandran V et al. Prolonged anginal perceptual threshold in diabetes: effects on exercise capacity and myocardial ischemia. *am collcardiol.* 1990;16(5):1120-4.
16. Jouvenx, Lemaitre RN et al. Diabetes, glucose level, and risk of sudden cardiac death .*Eur heart j.* 2005;26:2142-7.
17. Malmberg kl, Yusuf S et al. Impact of diabetes on long-term prognosis in patients with unstable angina and non-q-wave myocardial infarction: results of the oasis (organization to assess strategies for ischemic syndromes) registry. *Circulation.* 2000;102(9):1014-9.
18. The bypass angiography revascularisation investigation (BARI) in comparison of coronary artery bypass surgery with angioplasty in patients with multi vessel disease (correction 1997:388,147) *n eng j .med.* 1996;335:217:25)
19. Whang WI, Bigger JT et al. Diabetes and outcomes of coronary artery bypass graft surgery in patients with severe left ventricular dysfunction: results from the cabg patch trial database. *The cabg patch trial investigators and coordinators' am collcardiol.* 2000; 36(4):1166-72.
20. Scognamiglio RI, Negut et al detection of coronary artery disease in asymptomatic patients with type 2 diabetes mellitus. *J amcollcardiol.* 2006;47(1):65-71. E pub 2005 dec 9.
21. Consensus development conference on the diagnosis of coronary heart disease in people with diabetes: 10-11 February 1998, Miami, Florida. American diabetes association. *Diabetes care.* 1998; 21 :1551-9.
22. Achenbach S et al top 10 indications for coronary CTA. Ruling out stenosis in patients at low-to-intermediate risk for coronary artery disease tops the list, but coronary CT angiography has a much broader role to play. *Supplement to applied radiology;* 2006.
23. Schuijf JD, Bax JJ et al. Do risk factors influence the diagnostic accuracy of non-invasive coronary angiography with multi slice computed tomography? *J nuclideiolsept.* 2006; 13(5): 635-641.
24. Berman DS, Wong ND et al relationship between stress-induced myocardial ischemia and atherosclerosis measured by coronary calcium tomography. *Jam collcardiolaug.* 2004; 44(4): 923-930.
25. Juan j. Rivera, khurramnasir et al. Conducted a study to describe the detection of occult coronary artery disease in asymptomatic individuals with diabetes mellitus using non-invasive cardiac angiography. *Atherosclerosis.* 2009; 203 (2): 442-8.
26. Silva Jd, Mota P, Coelha A et al. Incidence of subclinical atherosclerosis in asymptomatic type-2 diabetic patients: the

- potential of multi-slice computed tomography coronary angiography. *Coron artery dis.* 2011;22(1):26-31
27. Kyle Balling et al. Assessment of plaque burden in asymptomatic diabetic patients by multi-slice CT angiography and coronary calcium scoring free. *J amcollcardiol.* 2012; 59 (13s1).
 28. M patel, VS Mehta et al. An evaluation of coronary artery plaque burden in asymptomatic type 2 diabetics using dual-source CT coronary angiograph. *BMC Proceeding.* 2012; 6(suppl):020.
 29. Munehirokamimura, masoaoomoroi, mitsuakiisobe et al. Role of coronary CT angiography in asymptomatic patients with type 2 diabetes mellitus. *Int heart j.* 2012; 53: 23-28.
 30. Rodolfo nasti, ornellacarbonara et al. Coronary artery disease is detectable by multi-slice computed tomography in most asymptomatic type 2 diabetic patients at high cardiovascular risk. *Diabvasc dis res.* 2012; 9(1):10-7.
 31. Zhao Menghua et al. Clinical significance of multi slice coronary CT angiography in asymptomatic patients with type 2 diabetes mellitus. *J Am Coll Cardiol.* 2014; 21.

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