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# CORONARY ARTERY DISEASE ON CT-CORONARY ANGIOGRAM – COMPARISON BETWEEN DIABETIC AND NON-DIABETIC POPULATION

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**Contribution**
MZZ conceived the idea and designed the study. Data collection and manuscript writing was done by MZZ, AA, SNIB, and RM. All the authors contributed equally to the submitted manuscript.

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## ABSTRACT

**Objective:** To evaluate the CT coronary angiograms of patients presenting with symptoms of coronary artery disease (CAD) as well as to compare the results between the diabetics and non-diabetics.

**Methodology:** This descriptive cross-sectional study was carried out in Cardiology department of Chaudhary Pervaiz Elahi Institute of Cardiology, Multan. One hundred and fifty nine patients with history of symptoms of CAD and no previous history of myocardial infarction or revascularization were included in study. The conventional risk factors were noted and 64 slice multi detector CT coronary angiogram was done on all patients. Total calcium score and number of segments with disease, obstructive disease and non-obstructive disease were noted. Results were compared among diabetic and non-diabetic patients.

**Results:** Mean age of the patients was 50.54±7.90 years. Out of 159 patients 118(74.2%) were males and 41 (25.8%) were females. Diabetic patients were 101(63.5%), 64 (40.3%) were hypertensive, 39(24.5%) were smokers, 24.5% (n=39) had positive family history, 18.2% (n=29) were obese and 13.8% (n=22) had dyslipidemia. There was no coronary artery disease in 40 (25.2%) patients while 91 (57.2%) patients had obstructive and 28 (17.6%) patients had non-obstructive disease. 83. 1% diabetics had obstructive CAD and 12.0% of non diabetic patients had obstructive CAD. Mean number of obstructive segments in diabetic patients are 2.36±1.23.

**Conclusion:** CAD was more prevalent in diabetic patients and CAD is easily predicted by non-invasive technique of CT coronary angiography.

**Keywords:** coronary artery disease, diabetes mellitus, CT coronary angiography

## INTRODUCTION

Diabetes Mellitus (DM) is a major public health problem of the present era. It is estimated that more than 200 million people are affected with DM world wide[1] and estimated prevalence of DM for 2025 is more than 300 million[2]. Coronary artery disease (CAD) is considered as the leading cause of morbidity and mortality in the diabetic patients[3]. Total mortality rate is two to four times higher in diabetic patients as compared to non-diabetic patients due to cardiovascular causes.[4] Usually diabetic patients with CAD are asymptomatic until they develop acute myocardial infarction or sudden cardiac death.[5] It has also been observed that CAD is usually more advanced and diffuse in diabetics at the time of diagnosis as compared to their non-diabetic counter parts.[6] All of these facts point towards the importance of timely diagnosis of coronary artery disease in diabetics and the risk stratification of the patients to save valuable lives from the dreadful consequences of CAD.

In the past few decades the noninvasive techniques have improved dramatically for the detection of coronary artery disease. Multidetector computed tomography (CT) coronary angiography provides a lot of information regarding the severity and extent of CAD as well as the characteristics of plaques and coronary calcium scoring[7]. The 64 slice CT coronary angiogram is reported to be a sensitive and specific tool for diagnosing significant CAD and literature has shown that it has validated against the conventional coronary angiogram as well as intravascular ultrasound.[8, 9] The role of CT coronary angiogram is not to detect patients with coronary artery disease rather to detect patients with extensive coronary artery disease versus those who have no atherosclerosis or non-obstructive coronary artery disease as patients with extensive coronary artery disease may get further testing with conventional coronary angiogram and later on subsequent revascularization to prevent adverse cardiac events.[10]

As CT coronary angiogram is a noninvasive tool and literature has shown that it has sensitivity and negative predictive value near 100% in diagnosing CAD.[11] That's why we planned a study to evaluate the CT coronary angiograms for diagnosing CAD in our local population of South Punjab region of Pakistan in patients suspected to have CAD according to history and presentation of patients as well as to compare the results between the diabetics and non-diabetics.

## METHODOLOGY

This descriptive cross-sectional study was carried out in out-patient department of Cardiology department of Chaudhary Pervaiz Elahi Institute of Cardiology, Multan from 1st of January, 2020 to 30th of June 2020. After approval from the Ethical Review Board of the hospital and taking informed consent from the patients, a total 159 consecutive patients of either gender of more than or equal to 40 years were included in the study.

All patients had symptoms of CAD like chest pain on exertion, shortness of breath, chest tightness and chest heaviness. None of the patient had history of acute coronary syndrome, coronary angiogram, revascularization and coronary artery bypass grafting in the past. The patients who had serum creatinine level of more than 2mg/dl or history of previous allergic reaction to iodine dye were also excluded from the study. The conventional risk factors for CAD were noted on a preformed questionnaire. The patient were labeled diabetic if already using hypoglycemic drugs either oral or parenteral or fasting blood sugar level of more than 126mg/dl, hypertensive if already on antihypertensive medication or recorded blood pressure of more than 140/90mmHg at three different occasions, smoker was labeled as positive who smoked more than 100 cigarettes in his/her life time, obese if body mass index was more than 30kg/m$^2$ and having dyslipidemia if total cholesterol level was more than 200mg/dl or getting treatment with cholesterol lowering drugs. Positive family history for CAD of the patient considered if the patient had first degree male relative of age less than 55 years and first degree female relative of age less than 65 years had history of CAD.

All the examinations were performed on a 64-detector CT-scanner Aquilion 64, Toshiba Medical Systems, Tokyo, Japan. If the heart rate of patient was more than 65 beats/ minute in morning electrocardiography it was controlled by using oral or intravenous beta-blocker, First of all coronary calcium data was obtained by using standard 4x3.0

mm collimation and then 1ml/kg body weight bolus (maximum 100ml) of nonionic iodinated contrast Ultravist-300 was given via power injector via antecubital vein followed by bolus of 50ml normal saline at the speed of 4-6ml/sec. Sure start technique with ROI placed on descending aorta at level of pulmonary trunk and trigger at 180HU was used to do cardiac CT. The Toshiba protocol consisted of the use of collimation, 64x0.5 mm; gantry rotation time 400 msec; tube voltage 120 kV; tube current, 300 mA and pitch 0.2–0.3. Axial, coronal and sagittal images were used to acquire the data required using retrospective electrocardiogram gating. The data set was recorded at the 75% of R-R interval.

To get optimal images in case of motion artifacts additional data was recorded at 25% and 85% of R-R interval. All CT coronary angiograms were evaluated by two different cardiologists with post fellowship experience of at least 5 years in the cardiac imaging. Coronary vessels were divided into 16 segments according to American Heart Association Classification for evaluation purpose.[12] All segments were evaluated for atherosclerotic plaques. Any segment with an atherosclerotic plaque was considered diseased segment. Diseased segments were classified into having obstructive plaques if they had more than 50% luminal narrowing visually and non-obstructive plaques if the segments ha less than or equal to 50% luminal narrowing. Total number of diseased segments, number of segments with obstructive plaques and number of segments with non-obstructive plaques were noted for each patient.

Computer software SPSS 20.0 was used to analyze the data. Continuous variables like age, total calcium score, number of disease segments, and number of segments with obstructive and non-obstructive plaques were expressed with mean and standard deviation. Qualitative variables like gender (male/female), diabetes (yes/no), hypertension (yes/no), smoking (yes/no), obesity (yes/no), family history (yes/no) and dyslipidemia (yes/no) were expressed as frequency and percentages. All conventional risk factors were also compared in diabetic and non-diabetic groups. Means and standard deviation of number of diseased segments, obstructive and non-obstructive segment and calcium scoring were calculated separately in diabetics and non-diabetics and compared via Chi-square test. p-value was calculated for both groups. P-value of less than 0.05 will be considered significant.

# RESULTS

Total 159 patients were included in the study. Mean age of the patients was 50.54±7.90 years. Out of 159, 118 (74.2%) were males and 41 (25.8%) were females. 63.5% (n=101) were diabetic, 40.3% (n=64) were hypertensive, 24.5% (n=39) were smokers, 24.5% (n=39) had positive family history, 18.2% (n=29) were obese and 13.8% (n=22) had dyslipidemia. 121 (76.1%) were presented with typical chest pain on exertion and relieved on rest and shortness of breath while 38 (23.9%) had atypical symptoms like epigastric discomfort or palpitations. There was no coronary artery disease in 40 (25.2%) patients while 91 (57.2%) patients had obstructive and 28 (17.6%) patients had non-obstructive disease. Overall mean of number of diseased segments was 3.55±1.94, mean of number of obstructive segments was 2.06±1.23 and mean of number of non-obstructive segments was 2.95±9.45. Overall mean of total calcium score was 166.54±92.05. Table 1 shows the cross tabulation of diabetes mellitus with the coronary artery disease and p-value. Table 2 shows the demographic and CT coronary angiographic features among the diabetes and non diabetes with the p-value.

**Table 1: Cross Tabulation of Diabetes Mellitus with the CAD**

| CAD | Diabetes Mellitus | | Total |
|---|---|---|---|
| | No | Yes | |
| Absent | 33 (56.9%) | 7 (6.9%) | 40 |
| Non-Obstructive | 18 (31.0%) | 10 (9.9%) | 28 |
| Obstructive | 7 (12.0%) | 84 (83.1%) | 91 |
| Total | 58 | 101 | 159 |

*P-Value<0.0001*

**Table 2: Demographic and CT coronary angiographic features of Diabetic and Non-Diabetic Patients**

| Features | Diabetics (n=101) | Non-diabetics (n=58) | P-value |
|---|---|---|---|
| **Gender** | | | |
| Male | 75 (74.2%) | 43(74.1%) | 0.987 |
| Female | 26 (25.7%) | 15 (25.9%) | |
| Age | 49.36±8.6 4 years | 53.16±6.2 3 years | 0.01 |
| Hypertension | 33 (32.7%) | 31 (53.4%) | 0.01 |
| Obesity | 28 (27.7%) | 1 (1.7%) | 0 |

| | | | |
|---|---|---|---|
| Smoking | 31 (30.7%) | 8 (13.8%) | 0.01 |
| Family History | 31 (30.7%) | 8 (13.8%) | 0.017 |
| Dyslipidemia | 20 (19.8%) | 2 (3.4%) | 0.004 |
| Number of disease segments | 3.71±1.91 | 2.96±1.97 | 0.007 |
| Number of obstructive segments | 2.36±1.23 | 2.06±1.21 | 0.016 |
| Number of non-obstructive segments | 3.19±10.28 | 2.09±1.04 | 0.01 |
| Total calcium score | 227.94±88.01 | 105.14±90 | <0.001 |

## DISCUSSION

Recently CT coronary angiography has been considered an ideal non-invasive alternative procedure for diagnosis of CAD. Improvement in technology increased the spatial and temporal resolution of image leading to increase diagnostic value of CT coronary angiogram in recent times [13]. On the other hand diabetes is associated with elevated risk of CAD. However its diagnosis at an early stage is still challenging [14]. Studies have shown that specificity of 93-98% and sensitivity of 83-99% of CT angiography for diagnosing CAD [15]. Thus CT coronary angiogram is quite helpful in diagnosing CAD in diabetic patients[14].

Blanke et al showed that CT coronary angiography is helpful in diagnosing both obstructive and non-obstructive atherosclerotic plaques in diabetic patients showing 52% diabetic patients with obstructive CAD and 40% of non-diabetic patients had obstructive coronary artery disease [16]. Similarly Kang et al reported that 31.6% diabetic patients had obstructive CAD with 2.8 ± 4.6 mean of number of obstructive segments [17]. Van Werkhoven et al showed 51% of diabetic patients with obstructive CAD with 1.7±2.8 mean number of obstructive segments [14]. Our study showed a higher prevalence of obstructive disease in diabetic patients. Our study showed 83.17% of diabetic patients with obstructive coronary artery disease with 2.36±1.23 mean number of obstructive segments. The probable cause of higher prevalence of obstructive disease in our local population of South Punjab is due to poorly controlled DM either due to poverty and illiteracy as well as many patients were not aware of their diabetic status till their hospital visit. A local study conducted at an hospital of Islamabad showed 63.7% of patients with obstructive coronary artery disease on CT angiogram [13]. These results are comparable to our study to some extent. Van Werkhoven showed total calcium scoring in diabetic patients of 440 ±786 [14] which is quite higher as compared to our local population which came out to be 227.94±88.01 which depicts that our diabetic patients have lower calcium scoring as compared to develop world.

This study also has limitations. First this is an observational study with a small sample size. Second this is probably the first study of its type on local population according to our knowledge and showed a lot of different results as compared to developed world. It's the need of hour that more randomized control trials with larger sample size should be conducted to see the pattern of CAD in our local population.

## CONCLUSION

In the light of the results of this study it is concluded that CAD is more prevalent in diabetic patients and CT coronary angiogram is an ideal non-invasive technique for the diagnosis of CAD.

## REFERENCES


1. Tian P, Zheng X, Li M, Li W, Niu Q. Long-term prognostic value of coronary computed tomography angiography for asymptomatic patients with CAD in type 2 diabetes mellitus. Exp Ther Med. 2019;18(1):747-54.
2. Animaw W, Seyoum Y. Increasing prevalence of diabetes mellitus in a developing country and its related factors. PloS One. 2017;12(11):e0187670.
3. Hajar R. Diabetes as "Coronary Artery Disease Risk Equivalent": A Historical Perspective. Heart Views. 2017;18(1):34-37.
4. Einarson TR, Acs A, Ludwig C, Panton UH. Prevalence of cardiovascular disease in type 2 diabetes: a systematic literature review of scientific evidence from across the world in 2007-2017. Cardiovasc Diabetol. 2018;17(1):83.
5. Young LH, Wackers FJ, Chyun DA, Davey JA, Barrett EJ, Taillefer R, et al. Cardiac outcomes after screening for asymptomatic coronary artery disease in patients with type 2 diabetes: The DIAD study: A randomized controlled trial. JAMA. 2009;301(15):1547-55.
6. Leon BM, Maddox TM. Diabetes and cardiovascular disease: Epidemiology, biological mechanisms, treatment recommendations and

future research. World J Diabetes. 2015;6(13):1246-58.
7. Kolossváry M, Szilveszter B, Merkely B, Maurovich-Horvat P. Plaque imaging with CT-a comprehensive review on coronary CT angiography based risk assessment. Cardiovasc Diagn Ther. 2017;7(5):489-506
8. Pugliese F, Mollet NR, Runza G, Meighem C, Meijboom WB, Malagutti P, et al. Diagnostic accuracy of non-invasive 64- slice CT coronary angiography in patients with stable angina pectoris. Eur Radiol. 2006;16:575–82.
9. Ropers D, Rixe J, Anders K, Küttner A, Baum U, Bautz W, et al. Usefulness of multidetector row spiral computed tomography with 64- x 0.6-mm collimation and 330-ms rotation for the noninvasive detection of significant coronary artery stenoses. Am J Cardiol. 2006;97(3):343-8.
10. Hachamovitch R, Hayes SW, Friedman JD, Cohen I, Berman DS. Comparison of the short-term survival benefit associated with revascularization compared with medical therapy in patients with no prior coronary artery disease undergoing stress myocardial perfusion single photon emission computed tomography. Circulation. 2003;107(23):2900-7.
11. Haase R, Schlattmann P, Gueret P, Andreini D, Pontone G, Alkadhi H, et al. Diagnosis of obstructive coronary artery disease using computed tomography angiography in patients with stable chest pain depending on clinical probability and in clinically important subgroups: meta-analysis of individual patient data. BMJ. 2019;365:l1945.
12. Austen WG, Edwards JE, Frye RL, Gensini GG, Gott VL, Griffith LS. Report of the Ad Hoc committee for grading of coronary artery disease, council on cardiovascular surgery, American Heart Association. Circulation. 1975;51(4 Suppl):5-40.
13. Awan MW, Yasrab, Rashid S. Diagnostic accuracy of 64 slice CT coronary angiography for diagnosing significant coronary artery stenosis. J Anesth Crit Care Open Access. 2018;10(3):105-108.
14. Van Werkhoven JM, Cademartiri F, Seitun S, Maffei E, Palumbo A, Martini C, Tarantini G, Kroft LJ, de Roos A, Weustink AC, Jukema JW. Diabetes: prognostic value of CT coronary angiography—comparison with a nondiabetic population. Radiology. 2010;256(1):83-92.
15. Syed MA. Coronary CT angiography: Current and evolving applications. Pak Heart J. 2010;43(1-2):8-15.
16. Blanke P, Naoum C, Ahmadi A, Cheruvu C, Soon J, Arepalli C et al. Long-Term Prognostic Utility of Coronary CT Angiography in Stable Patients With Diabetes Mellitus. JACC Cardiovasc Imaging. 2016;9(11):1280-8.
17. Kang S H, Park G M, Lee S W, Yun S C, Kim Y H, Cho Y R et al. Long-Term Prognostic Value of Coronary CT Angiography in Asymptomatic Type 2 Diabetes Mellitus. JACC Cardiovasc Imaging. 2016;9(11):1292-300.