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Assessment of Coronary Arteries Calcification in Diabetic Patients by using CT Calcium Score Technique

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Abstract **Original Research Article**

This study designed to define the role of computed tomography coronary angiography (CTA) in the diagnosis of patients with chest pain and suspected to have coronary artery disease (CAD) by measuring the calcium scoring in the coronary arteries (CAC) in patient with known diabetes and correlate the results with the (CTA) findings and other related variables. A descriptive analytical study for 84 patient with 36 diabetes and 48 patient with diabetes and hypertension examined using multi-detector computed tomography scanner MDCT64-Slice scanner (0.625 mm slices): 64 slice 0.625 mm collimation, table feed 10 mm/rotation, effective tube current 685 mAs at 120 kV. Pitch = 10/40 mm, collimation = 0.25 Average scan time = 5s, to scan the patient with coronary problems, detector array, fan beam shape, CT monitor for controlling scanning and processing. Cardiac trigger monitor with electrode leads (3000 TOSHEIBA) to monitor the heart rate, contrast injector (Medrao Toshiba-2ways) for flush contrast media to patient and VITREA SYSTYM (TOSHIBA) for diagnosis images and reconstruction and volume rendered purposes.(CAC) offers identifying the patients intended to have cardiac events, diagnosis of coronary arteries lesions and characterizing the plaque pattern .It is believable that measurements of calcium score will provide an acknowledged analytical radiological tool for the diagnoses of (CAD).

Keywords: Multi-detector computed tomography, Plaque type, CAD.

1. INTRODUCTION

Multidetector computed tomography coronary angiography (MDCTA) has recently emerged as a new imaging modality for the non-invasive evaluation of coronary artery disease CAD [1]. This technique allows detailed visualization of luminal narrowing as well as atherosclerotic changes within the coronary vessel wall. It enables an accurate noninvasive identification and quantification of calcified coronary plaques [2]. Recent studies put in evidence the need of assessing additional plaque morphologic considerations in order to define the most appropriate treatment [3]. Most important is the type of plaque (fatty, mixed or calcified) [4].

The coronary calcium is an important marker for plaque problems, and it is suggested that future coronary events may be predicted on the basis of the calcium score [5]. However, there is significant heterogeneity among atherosclerotic lesions, and coronary plaques often consist of non-calcified tissue [6]. Thus, even in coronary vessels without calcified plaques, severe atherosclerosis may be present. Moreover, non-calcified lesions may also contribute to the development of acute coronary events [7]. Therefore, a more precise evaluation of coronary atherosclerotic plaque by imaging tools that can detect and characterize calcified and non-calcified plaques can be expected to add important information [8].

So far, no data is available on the clinical feasibility of MDCT to find out the composition of coronary plaques. Moreover, the correlation of plaques types with coronary calcium scoring [9], therefore, designed a study to define the current role of multi slice computed tomography (MSCT) for the diagnosis of patients with chest pain and suspected to have coronary artery disease (CAD) using Quantitative Coronary Angiography Calcium Values Based On Computed Tomography in Right Coronary Artery (RCA), Left Anterior Descending Artery (LAD), Left Circumflex Coronary Artery (LCFX).and correlate the results with

the atherosclerotic changes, coronary arteries findings and plaque pattern [10].

2. MATERIALS AND METHODS

The study was executed using multi-detector computed tomography scanner MDCT64-Slice scanner (0.625mm slices): 64 slice 0.6.25 mm collimation, table feed 10 mm/rotation, effective tube current 685 mAs at 120 kV. Pitch = 10/40 mm collimation = 0.25. Average scan time = 5 s, to scan the patient with coronary problems, with 64-slice (all machines), detector array, fan beam shape, CT monitor for controlling scanning and processing. Cardiac trigger monitor with electrode leads (3000 TOSHEIBA) to monitor the heart rate, contrast injector (Medrao Toshiba-2ways) for flush contrast media to patient and VITREA SYSTYM (TOSHIBA) for diagnosis images and reconstruction and volume rendered purposes.

In 84 patients (56 male, 28 female; mean age, 57years) were included. MDCTA was performed. Patients with contraindications to iodinated contrast agent, and unstable clinical presentation, calcium scoring more than 1000, bypass surgery were excluded. The Research Counsel Board -College of Medical Radiological Science approved the research protocols. All patients underwent MDCTA of the coronary vessels by using a 64 row MDCT Toshiba system. Patients were placed in the supine position; Patients were also instructed not to breathe for 10-30 second during coronary artery angiography examination. Contrast medium was injected using power injector. Scanning started 5 seconds after enhancement in the aorta reached 60 HU.

Axial images were analyzed. Cardiac trigger monitor with electrodes leads (3000 Toshiba) to monitor the heart rate, contrast injector (Medrao Toshiba) for flush contrast media to the patient and VITREA SYSTEM for diagnosis images and reconstruction and volume rendered purposes were used. For patient's preparation, caffeine and drugs that increases the heart rate were avoided 24 hrs. Prior to the cardiac CTA investigation. When b-blocker was used, patients with bronchial asthma, heart failure were contraindicated and have to be ruled out. In cases where the heart rate of the patients was above 60 bpm, the scan was not performed. Monitoring of vital function (heart rate) was checked. The patient's age, heart rate, and calcium score were evaluated, the arteries including left anterior descending artery (LAD), right coronary artery (RCA), left circumference artery (LCXR) were characterized for CAD according to the CT outcome. Plaques were characterized as (soft, mixed, calcified and non-calcified). Statistical Analysis: All data were presented as mean± SD values. Data were analyzed by an independent t test and by correlation analysis with the use of the SPSS (Inc., Chicago, Illinois version 16). A value of $P<0.05$ was considered significant.

RESULTS

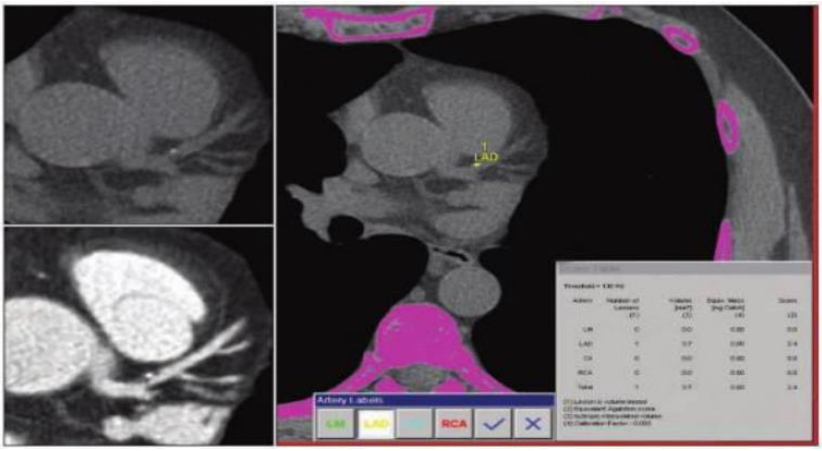

Fig-1: Calcium scoring Non-contrast-enhanced 'calcium scoring' image of a patient with a small calcification in the proximal left anterior descending coronary artery (LAD) (right panel). Comparison of the non-contrast-enhanced image (left upper panel) and contrast-enhanced image (left lower panel).

Table-1: Showed variables statistics for 84 patients including the scoring values

Variables	Mean	Std. D
Age	56.667	10.7461
BMI	33.198	5.7651
CA score	*63.810*	*114.9455*
RCA	*14.774*	*39.1384*
LCRX	*8.131*	*21.9302*
LAD	*39.690*	*79.6849*

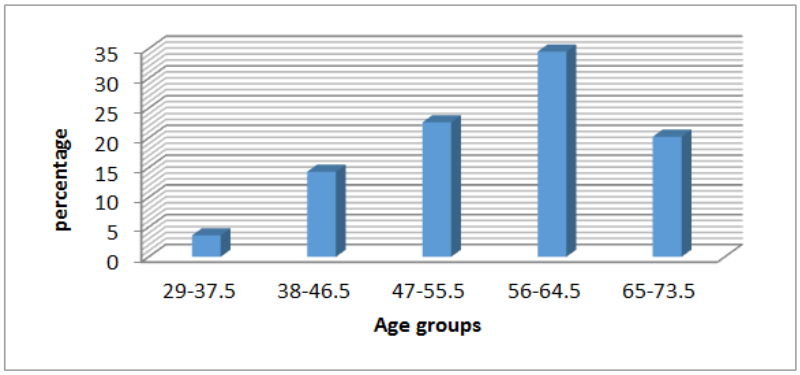

Fig-2: Showed frequency distribution of age groups in the study

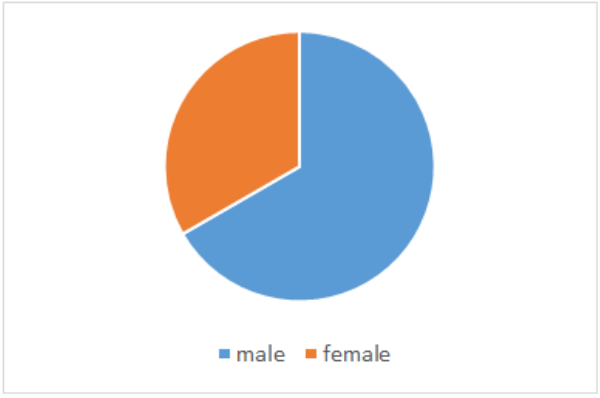

Fig-3: Showed gender distribution among study sample

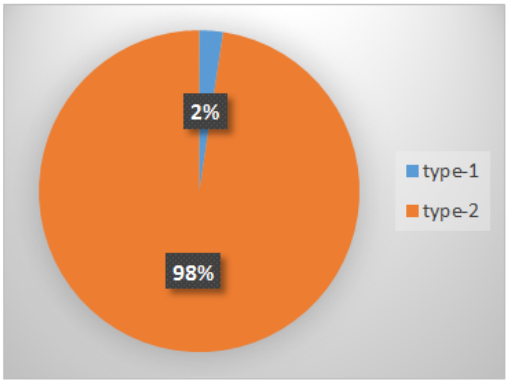

Fig-4: Showed distribution of diabetes type among study sample

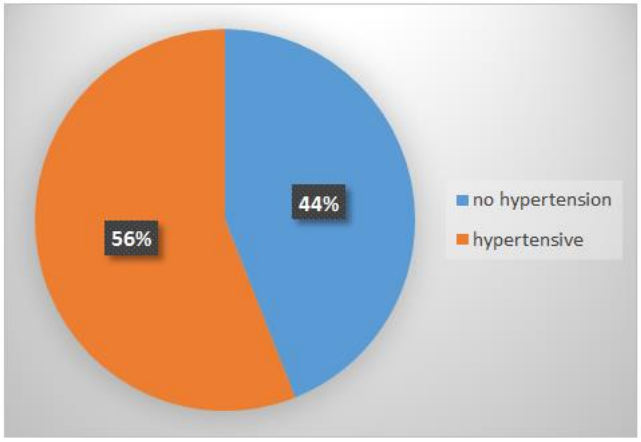

Fig-5: Showed distribution of HTN groups

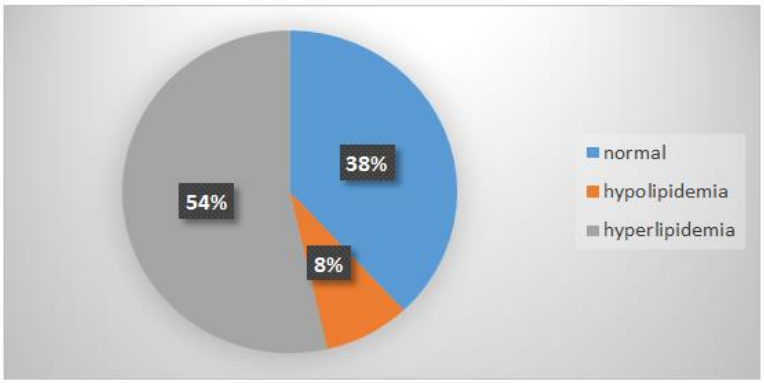

Fig-6: Showed distribution of cholesterol levels

Table-2: Independent t-test showed the difference between the ca. score for different age groups

	Age	N	Mean	Std. Deviation
Ca. Score	29-37.5	3	0.000	.0000
	38-46.5	12	45.167	98.2768
	47-55.5	19	61.947	164.0035
	56-64.5	29	55.724	88.2282
	65-73.5	17	79.294	102.7769
	74-83	4	169.250	132.1398
P-vale =0.867				

Table-3: Independent t-test showed the difference between the ca. score for hypertensive and non- hypertensive patient in PRCA

	HTN	N	Mean	Std. Deviation
PRCA1	NON-hypertension	37	9.730	25.4576
	hypertensive	47	18.745	47.1185
P-vale =0.29				

Table-4: Independent t-test showed the difference between the ca. score for hypertensive and non- hypertensive patient in LCRX

	HTN	N	Mean	Std. Deviation
LCRX	no hypertension	37	6.324	18.0571
	hypertensive	47	9.553	24.6557

Table-5: Independent t-test showed the difference between the ca. score for hypertensive and non- hypertensive patient in LAD

Group Statistics				
	HTN	N	Mean	Std. Deviation
LAD	no hypertension	37	42.784	82.4157
	hypertensive	47	37.255	78.2786
P-vale =0.756				

Table-5: Independent t-test showed the difference between the ca.score in type-1 and type-2 diabetes

	DM	N	Mean	Std. Deviation
Ca. Score	Type-1	2	.000	.0000
	Type-2	82	65.366	115.9125
P-vale =0.000				

Table-6: Independent t-test showed the influence of ca. score in the PRCA branch

	DM	N	Mean	Std. Deviation
PRCA	Type-1	2	0.000	0.0000
	Type-2	82	15.134	39.5489
P-vale =0.001				

Table-7: Independent t-test showed the influence of ca. score in the LCRX branch

	DM	N	Mean	Std. Deviation
LCRX	Type-1	2	.000	.0000
	Type-2	82	8.329	22.1616
P-vale =0.001				

Table-8: Independent t-test showed the influence of ca. score in the LAD branch

	DM	N	Mean	Std. Deviation
LAD	Type-1	2	.000	.0000
	Type-2	82	40.659	80.4153
P-vale =0.000				

DISCUSSION

Diabetic now days is one of the major health problem that can affect the majority of people worldwide, that lead to many morbidity as well as it can affect several vital organs in which the heart was important one. Cardiac manifestation of this disease can be as deposition of calcium in or plaque demonstration in many cases reported at this study, which aimed to investigate the effect of this type of disease in coronary artery disease specially in atherosclerosis using MDCT -Ca scoring, in which was measure as total and then measured for RCA, LCXR, and LAD which equal to 63.810, 14.8, 8.1, and 39.7 as mean value respectively. This study done in both type of diabetes but type two was the focus of its objective where consisting of 97.6% of study populations, as in fig (4).

The age of the disease occurrence is one major factor affect both diabetic and cardiac disease here in current study we found that the common age at time of diagnosis is (56-65) accounted for 34.5% form total studied populations Table (2).

Figure (3) demonstrate that male was most frequent in this study where it's predominant rather than female account for 66.7 Vs 33.3 respectively. In correlation with other finding of the patient morbidity hypertension having strong correlation with atherosclerosis of PRCA at p=0.29 in which have mean value of 18.7 for 47 patient. Also relative impact of none hypertensive patient was demonstrated.

Ca score now a days having great values in demonstrating the CAD in which the invasive procedure was minimized as much as successfulness of such procedure, here Ca scoring was higher in most elderly patient (74-83) in which having mean value of 79.3, and followed by (47-56) having 61.9 as mean value.

A significant correlation was noted between Ca in three tested branches and the type of diabetic in which mostly affected by type-2 disease rather than type-1.Most patient come with hyperlipidemia status in which having strong correlation with the presence of the atherosclerotic disease in cardiac vessels.

CONCLUSION

This study revealed that 50% of diabetic patient have calcium score (42 out of 84), all of them with Type II diabetes. The ratio of diabetic male patient with calcium score is 53.5% (30 out of 56), while the ratio of female diabetic patients with calcium score is 42.9% (12 out of 28).The study also showed that the incidence of calcium score increase with age. Diabetic patients are at greater risk for developing atherosclerosis than their non-diabetic.

RECOMMENDATION

Diabetic patient should control the sugar level because it is a risk factor for atherosclerosis suggesting that preventive techniques needed to be established in the future to avoid the greater risk of atherosclerosis. Further study should be done with increase the sample size.

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