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Correlation between carotid intima-media thickness and severity of coronary artery disease in diabetic versus non-diabetic patients

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Abstract
Objectives: To declare the role of Carotid intima-media thickness (CIMT) as a predictor of the severity of Coronary artery disease (CAD) comparing with Syntax (SX) score in patients undergoing coronary angiography.
Methods: The present study includes 200 patients (100 patients were diabetics and 100 were not known to be diabetics), diagnosed as patients with CAD, outpatient or admitted in Al-Azhar university Assiut hospital and sohag cardiac specialized centre were included in the study. Demographic characteristics, risk factor profile, laboratory test results, electrocardiographic and echocardiographic findings and coronary angiography findings were assessed.
Results: A total of 200 patients were registered for the study. The mean±SD age of the study population was [58.61±9.12] years. Fifty two of patients were females (26%) and one hundred and forty eight were males (74%). 50% of our study group were diabetics, 58% were hypertensives, 39% were smokers, 15% were ex-smokers, 45.5% had dyslipidemia, 46% were obese, 20.5% had positive family history. 43% had STEMI, 27% were UA and 30% were NSTEMI. 71.5% had multi-vessel affected and 28.5% had single vessel affected. Regarding the type of affected vessel 13% was LMT, 81% was LAD, 44.5% was LCX, 58.5% was RCA, 21% was D and 17.5% was OM. The patients were divided into two groups, diabetic group and control group. The mean CIMT was significantly higher in diabetic group than control group (0.980±0.300) (0.883±0.287) respectively with P value <0.020. The mean SX score was significantly higher in diabetic group than non-diabetics (24.495±17.010) (19.275±13.730) with P value <0.018.
Conclusion: There is a significant correlation between CIMT and SX score in patients undergoing coronary angiography because of suspected CAD. Therefore, CIMT may not only be associated with CAD extent and severity but also with its complexity.

Keywords: coronary artery disease, CIMT, coronary angiography, syntax score

Introduction
Cardiovascular disease (CVD) is the leading cause of morbidity and mortality for both men and women worldwide [1].
CVD is one of the leading causes of death in the world and it is clear that atherosclerosis, which is a precursor to coronary heart disease and stroke, starts at an early age, therefore the identification of modifiable risk factors for adult CVD in youth has been a high priority [2].
Worldwide stroke is the second leading cause of death after ischaemic cardiac disease representing 10% of all deaths per year (5.4 million deaths) [3].
The development of new preventive therapies is one of the steps to control the CVD epidemic. It is increasingly demanded that promising therapies be evaluated in trials using cardiovascular morbidity and mortality as a primary outcome. These studies may show a direct effect on atherosclerosis progression and in the same time may serve to direct or exclude subsequent large mortality and morbidity trials [4].
Atherosclerosis is a syndrome affecting arterial blood vessels due to a chronic inflammatory response in the walls of the arteries. This response is promoted by low density lipoproteins (LDL) and inhibited by high density lipoproteins (HDL). Atherosclerosis is a chronic disease that may remain asymptomatic for decades. Atherosclerosis affects mostly large vessels such as coronary, carotid, cerebral, femoral and renal arteries. Hardening and narrowing of the arteries results from athermanous plaques [5].
There is a significant correlation between CIMT and Syntax (SX) score in patients undergoing coronary angiography because of suspected CAD. Therefore, CIMT may not only be associated with CAD extent and severity but also with its complexity [6].

Aim of the study
The Aim of this study is to to declare the role of Carotid intima-media thickness (CIMT) as a predictor of the severity of Coronary artery disease (CAD) comparing with Syntax (SX) score in patients undergoing coronary angiography.

Patients and methods
We studied 200 patients (100 patients are diabetics and 100

patients are not diabetics), diagnosed as patients with CAD, outpatient or admitted in Al-Azhar university Assiut hospital and sohag cardiac specialized centre between March 2017 and April 2018.

Criteria for Exclusion: Patients with end-stage renal disease, patients with end-stage liver disease, haemodynamically unstable patients and uncontrolled hypertension.

All patients in this study were subjected to:

Full History taking: Especially history of risk factors for CAD as: hypertension (HTN), diabetes mellitus (DM), positive family history of CAD, smoking, and dyslipidemia.

Complete physical examination: general and local cadiac examinations.

Laboratory investigations: Kidney & liver function, co-agulation & lipid profiles, CBC, and cardiac enzymes.

Electrocardiography: 12 lead ECG for all patients to diagnose each type of ACS.

Echocardiography: For assessment of left ventricular systolic function, diastolic function, wall motion abnormalities and valvular structure and function.

Carotid U/S: using High-resolution B mode, colour Doppler and pulse Doppler ultrasonography of both carotid arteries equipped with a 7.5-MHZ linear array transducer. Patients were examined in the supine position with the head tilted backwards. After the carotid arteries were located by transverse scans, the probe was rotated 90o to obtain and record a longitudinal image of the anterior and posterior walls. The IMT was defined as the distance between the leading edge of the lumen-intima echo and the leading edge of media-adventitia echo. At least three measurements were taken over 1-cm length of far wall of each CCA segment and these measurements of both sides were averaged to obtain the mean IMT. When plaque was present in the segment used for measuring the mean IMT, the plaque thickness was averaged into the mean IMT measurement.

Coronary angiography

All coronary angiographies assessed by an experienced operator blinded to all other clinical data. The angiography assessed for the severity and distribution of coronary affection according to syntax score. SYNTAX score is a scoring system used to estimate the severity of CAD through coronary angiography, on the basis of coronary anatomic risk factors. These factors include: the number of lesions, total occlusion, bifurcation, trifurcation, ostial stenosis, tortuosity, calcification, thrombus, diffuse lesion and small vessel/diffuse disease.

Results

Demographic data of the study group

Table 1: Demographic data of the study group showed that the mean age in our study was 58.61±9.12, and about sex showed 74% were males and 26% were females.

Item		Value
Sex	Male n(%)	148(74%)
	Female n(%)	52(26%)
Age	Mean±SD	58.61±9.12
	Median(range)	58(34-81)

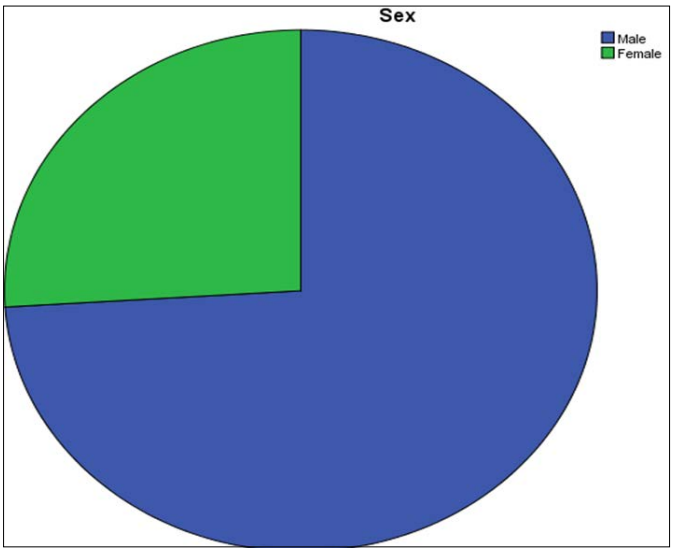

Fig 1: Distribution of sex of the study group.

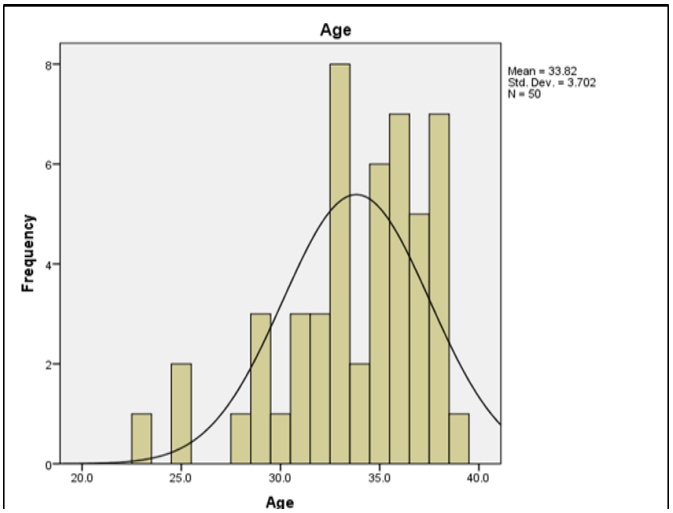

Fig 2: The mean of age in our study.

Risk factors

Table 2: Risk factors showed that 50% of our study group were diabetics, 58% were hypertensive, 39% were smokers, 15% were ex-smokers, 45.5% had dyslipidemia, 46% were obese, 20.5% had positive family history.

Item		Value
Hypertension	Yes	116(58%)
	No	84(42%)
Diabetes Mellitus	Yes	100(50%)
	No	100(50%)
Smoking	Smoker	78(39%)
	Non smoker	92(46%)
	Ex-smoker	30(15%)
Dyslipidemia	Yes	91(45.5%)
	No	109(54.5%)
Obesity	Yes	92(46%)
	No	108(54%)
Family History	Yes	41(20.5%)
	No	159(79.5%)

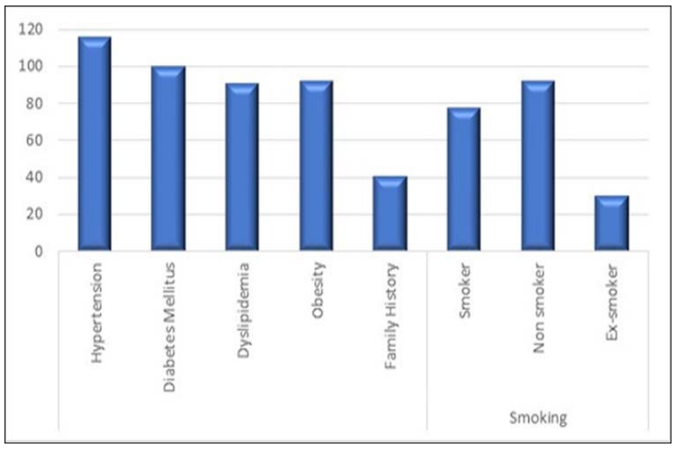

Fig 3: Risk factors percentage

Diagnosis

Table 3: Diagnosis showed that 43% of our study group diagnosed as STEMI, 27% were UA and 30% were NSTEMI

		No	%
Diagnosis	Stemi	86	43
	Nstemi	60	30
	UA	54	27

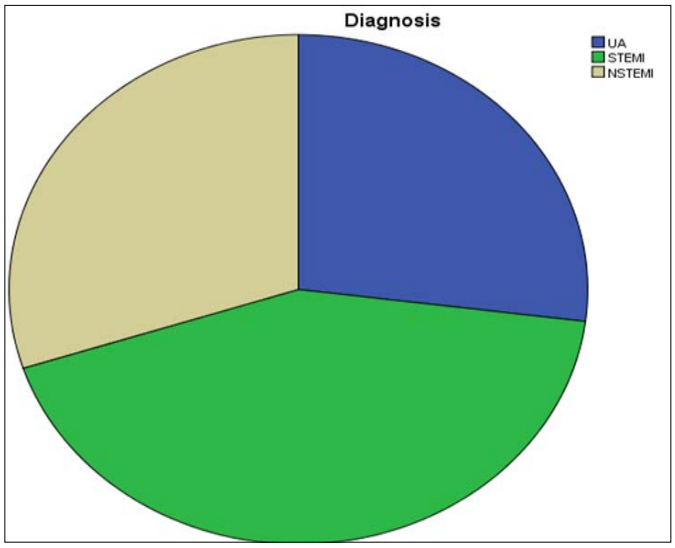

Fig 4: Diagnosis

Ejection Fraction

Table 4: Ejection Fraction showed that the mean EF of our study group was 58.39.

Mean	58.39
Median	58.00
Std. Deviation	7.236
Minimum	26
Maximum	73

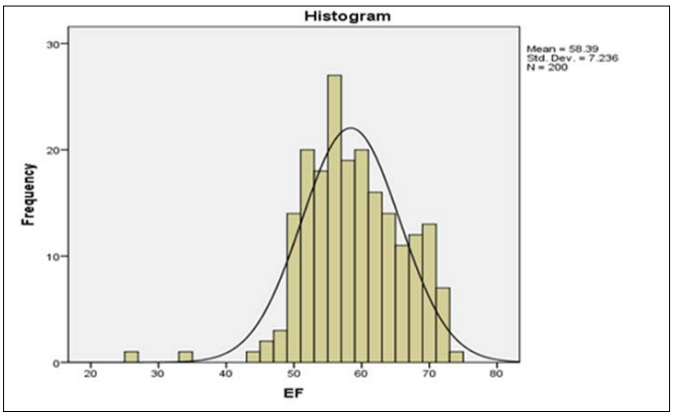

Fig 5: Echographic findings (left ventricular ejection fraction)

Coronary angiography data

Table 5: Coronary angiographic data showed that 71.5% had multi-vessel affected and 28.5% had single vessel affected. Regarding the type of affected vessel 13% was LMT, 81% was LAD, 44.5% was LCX, 58.5% was RCA, 21% was D and 17.5% was OM.

Item		No(%)
Type of affected vessels		
LMT		26(13%)
LAD		162(81%)
LCX		89(44.5%)
RCA		117(58.5%)
D		42(21%)
OM		35(17.5%)
Number of affected vessels	MVD	143(71.5%)
	SVD	57(28.5%)

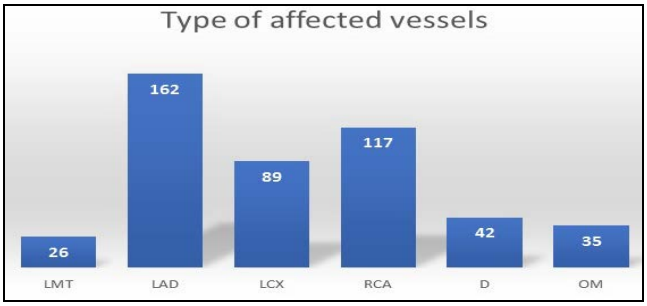

Fig 6: Type of affected vessel of the study group.

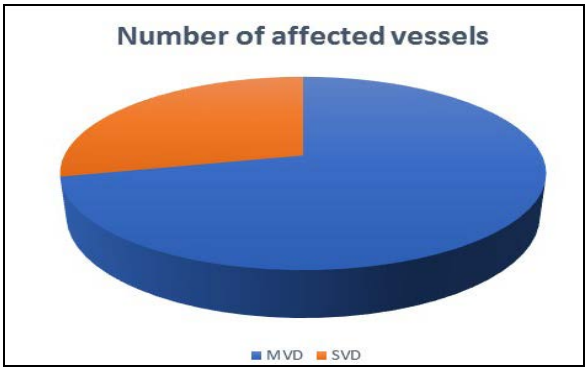

Fig 7: Number of affected vessels of the study group.

Comparison of CIMT between diabetics and non-diabetics

Table 6: CIMT showed that CIMT was significantly higher in diabetic group than non-diabetics.

	Diabetics	Non diabetics	T test	P value
CIMT	0.980±0.300	0.883±0.287	2.338	0.020(S)

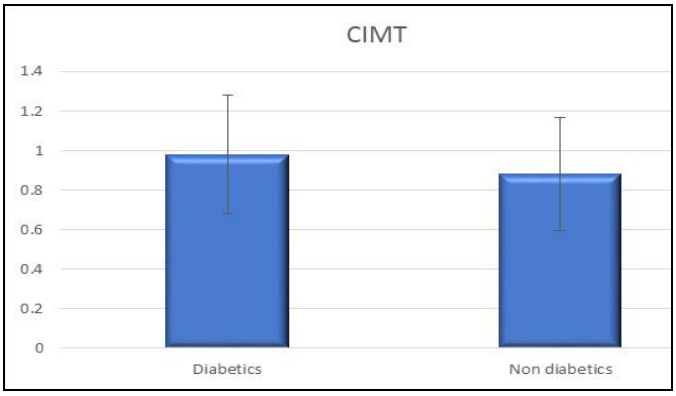

Fig 8: CIMT of the study group.

Comparison of Syntax score between diabetics and non-diabetics

Table 7: Syntax score showed that syntax score was significantly higher in diabetic group than non-diabetics.

	Diabetics	Non diabetics	T test	P value
Syntax score	24.495±17.010	19.275±13.730	2.388	0.018(S)

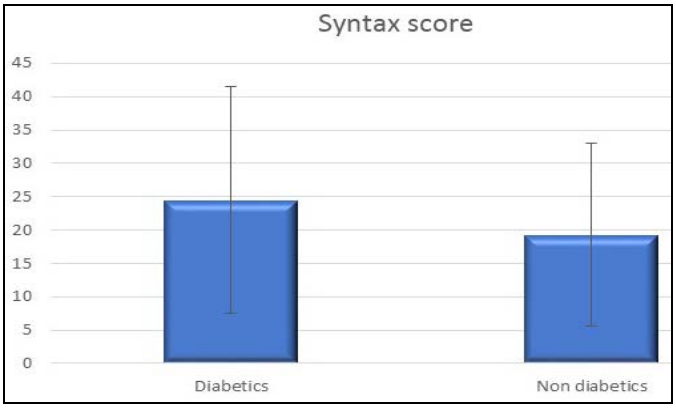

Fig 9: Syntax score of the study group.

Discussion

In the present study, the mean age was (58.61±9.12) years old which is very similar to that found in other study done by Shiran *et al*, 2011 to correlate between CIMT and CAD in India as it was (58.72) years [7]. In the study conducted by Montero *et al*, 2017, the mean age was (60.9) years [8]. The mean age in the study conducted by suleyman *et al*, 2016 in Turkey was (61) years [9].

In the present study (74%) of patients were males. Our results are in agreement with a study done by Nobutaka *et al*, 2012 in Japan, males compromised (62.9%) of the patients [10].

In the present study, the risk factor analysis revealed that (50%) of patients had DM, (58%) of patients had hypertension, (39%) were smokers, (15%) were ex-smokers, (45.5%) were dyslipidemic, (46%) were obese and (20.5%) had positive family history of CAD., Our results are in agreement with study conducted by Bahall *et al*, 2018 in which Risk factor analysis revealed that DM was present in 63% of population, hypertension was present in 74% of population, 34% of population were current or previous smokers and 30% of patients have family history of CAD [11].

In the present study, most of patients were presented by STEMI (43%) while presentation with NSTEMI was in (30%) of patients and UA present in (27%) of patients. Our results are in agreement with a study done by Maroszyńska *et al*, 2016 in which presentation by STEMI was (52.8%) while NSTEMI was (17.6%) and UA was (29%) [12]. In the study done by Hussein *et al*, 2013, patients presented by STEMI were (68%) while a history of angina and unstable angina were found in (21.5%) and (10.5%) of the patients respectively [13]. The study conducted by Burak *et al*, 2018 revealed that patients presented by STEMI were (55%) while NSTEMI were (45%) regarding the diabetic group [14].

The present study showed that (71.5%) of patients had multi-vessel affected and (28.5%) had single vessel affected. Regarding the type of affected vessel (13%) was LMT, (81%) was LAD, (44.5%) was LCX, (58.5%) was RCA, (21%) was D and (17.5%) was OM. In a published review conducted by Bhardwaj *et al*, 2014 SVD was seen in (51.3%) patients, MVD in (33%) patients. LAD was the commonest vessel involved (62.4%) [15]. In the study done by Santosh *et al*, 2017 SVD was observed in (71.5%), MVD in (22.7%) and LM in (3.2%). LAD was the affected vessel in 58.1%, RCA in 28.2% and the LCX in 13.7% patients [16].

The present study showed that the mean CIMT among diabetic patients was (0.980±0.300) while among non-diabetics it was (0.883±0.287). CIMT was significantly higher in diabetic than non-diabetic patients. Agarwal et.al, 2008 study showed that the mean CIMT had a highly significant ($p<0.01$) correlation with left-and right-CIMT as well as duration of diabetes and age ($p<0.01$) [17]. Mohan *et al*, 2000 in the Chennai Urban Population Study (CUPS) studied IMT of the carotid artery in South Indian diabetic and non-diabetic subjects and observed that the mean IMT value of the diabetic subjects (0.95 ± 0.31 mm) was significantly higher than those of the non-diabetic subjects (0.74 ± 0.14 mm) ($p<0.001$) [18]. The study conducted by Jadhav *et al*, 2004 showed that CIMT greater than 0.8 mm was observed in diabetic CAD patients as against those non-diabetics [19].

The present study showed that the mean syntax score among diabetic patients was (24.495±17.010) while among non-diabetic ones, it was (19.275±13.730). Syntax score was significantly higher in diabetic than non-diabetic patients. The study conducted by Garg *et al*, 2014 showed that the mean SX score was significantly increased with increasing HbA1c level (9.9% ± 12.2%, 12.9%±12.7%, 15.4%±15.2%, 19±15.5% in patients with HbA1c levels less than 5.5%, 5-5.7%, 5.8-6.1% and >6.1% respectively) with p trend less than 0.001 [20]. In a study done by Mukund *et al*, 2016, a significant difference with respect to SX score (p=0.019) was observed between non-diabetes and different time intervals of T2DM [21]. Our results are concordant with a study done by Jinling *et al*, 2014 in which HbA1c levels and SX score were correlated (r = 0.371; p, 0.001). [22] Moreover, the higher HbA1c categories

were able to independently predict patients with intermediate or high SX score (SX score ≥ 23) after the age, sex, hypertension, smoking, dyslipidemia, and creatinine levels were adjusted in the logistic regression analysis. Our results are concordant with a study done by Xishan *et al*, 2015 showed that the angiographic SX scores were higher in the subjects with known ($p<0.001$) or previously unknown ($p<0.001$) T2DM than in the subjects with normal FPG [23]. A study conducted by Hua *et al*, 2014 in china showed that the DM group had higher follow-up diastolic blood pressure (DBP), baseline FBG, PBG, HbA1c, Gensini score, SX score, and number of diseased vessels than the NGT (normal glucose tolerance) group [24].

Conclusion

- There is a significant correlation between CIMT and SX score in patients undergoing coronary angiography because of suspected CAD. Therefore, CIMT may not only be associated with CAD extent and severity but also with its complexity.
- The carotid plaque score and the mean CIMT showed excellent negative predictive value for the presence of complex coronary artery lesions.
- CIMT is significantly higher in diabetic patients than in non-diabetic subjects and an increased CIMT is associated with angiography-evaluated CAD and predicts future events of silent brain infarction and coronary heart disease in type 2 diabetic subjects.

Limitations

- It included only two medical center, do not represent the whole community.
- The number of our study population is not large enough to consolidate our findings.
- It would also be interesting to follow up the patients for prognostic significance. Large-scale prospective studies are needed to obtain further information

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