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Correlation between Coronary Artery Diseases and Dyslipidemia in Type 2 Diabetic Patients

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ABSTRACT

Background: Premature atherosclerotic cardiovascular disease (CVD) has a significant association with diabetes mellitus. There are numerous studies showing that decreasing cholesterol is effective in improving cardiovascular outcomes in people with diabetes. **Objective:** This study aimed to identify the correlation between coronary artery diseases (CADs) and dyslipidemia in diabetic patients.

Patients and methods: In the Cardiology Department of Zagazig University Hospitals we conducted this case-control study. 140 patients with type 2 DM were divided into two groups: Group 1 included 70 people with type 2 diabetes who had CADs and group 2 that included 70 patients with type 2 DM who had no signs of CADs (admitted complaining of symptoms of angina or CA showing no significant stenotic lesions). Angiographic examination and fasting and 2-hour postprandial blood glucose levels were performed for all patients. Moreover, comprehensive history was taken, cardiovascular risk profiles and laboratory investigations such as glycosylated hemoglobin (HbA1c) were done.

Results: CAD group were significantly higher regarding BMI as it was distributed as 28.77 ± 2.3 and 30.04 ± 3.03 between No-CAD and CAD respectively. There was no significant difference or association between smoking or hypertension and CAD. SBP and DBP were significantly higher among CAD. Fasting blood glucose and HbA1c were significantly higher among CAD group than in No-CAD group. CAD group showed significantly higher TG and LDL-c distribution than No-CAD group.

Conclusion: Increased triglycerides and decreased HDL levels were associated with CVD among diabetic patients.

Keywords: Coronary artery diseases, Dyslipidemia, Diabetes mellitus.

INTRODUCTION

A prominent public health issue in the world is cardiovascular disease (CVD). Research shows that diabetics are twice to four folds as likely to develop coronary artery disease or have a myocardial infarction (MI), verifying the hypothesis that type 2 diabetes is a risk factor for both stroke and heart disease [(1)]. Atheromatous alteration in coronary vessels causes a wide spectrum of disorders, including coronary artery disease (CAD). In the past, CAD was assumed to be only a straightforward, inexorable process of artery narrowing, eventually causing a full blockage of the vessels. It was discovered that there are several types of coronary plaques, with some being stable (lipid-poor) while others are more unstable (lipid rich), which shifted the explanatory paradigm in recent years [(2)].

A tight relationship exists between diabetes mellitus (DM) and coronary artery disease (CAD), with DM serving as a significant risk factor for CAD and even being regarded as being equal to existing CAD [(3)]. Diabetes increases the risk of early atherosclerosis and cardiovascular disease in diabetics. Clinical research has shown that strict glycemic management has no effect on cardiovascular health. When a person has diabetes, they are more likely to have dyslipidemia, and research shows that decreasing cholesterol can improve cardiovascular outcomes even in those with otherwise normal lipid profiles [(4)].

The American Heart Association classifies dyslipidemia as being in the 95th percentile or higher in the general population of the United States as there is a high level of total cholesterol > 5.2 mmol/L (200 mg/dl), LDL cholesterol is greater than 3.4 mmol/L (130 mg/dl), high-density lipoprotein cholesterol is less than 0.9 mmol/L (35 mg/dl), or a mix of these levels is present [(5)]. We aimed in this work to identify the correlation between coronary artery diseases and dyslipidemia in diabetic patients.

PATIENTS AND METHODS

Case-control research was conducted at Cardiology Department, Zagazig University Hospitals. 140 patients with diabetes mellitus type 2 were the only considered. They were divided into two categories: 70 patients in group 1 who had diabetes type 2 and CADs and 70 patients with type 2 diabetes who don't have any signs of coronary artery disease (only complaining of symptoms of angina or CA showing no significant stenotic lesions) and worked as group 2 (No-CAD group).

Inclusion criteria: Those with diabetes mellitus type 2 (NIDDM) were included if they had a history of coronary artery disease (CAD) and had chest pain that was not related to their blood sugar levels (glycemic variability). The femoral or radial technique was used for coronary angiography, with the Gensini score being used to determine the degree of coronary artery disease.

Exclusion criteria: The study excluded diabetics with any of the following risk factors: smoking, drinking, high blood pressure, liver illness, kidney disease, and those who had not undergone coronary angiography.

All patients were subjected to the following procedures:

Clinical evaluation and full history taking were

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performed on all patients.

Diagnostic tools:

Electrocardiogram:

An ECG with 12-lead recording at rest to look for signs of related CADs. New ST elevation at J point in two contiguous leads with cut-points of 0.1 mV or less was necessary in all leads except V1–V3, where elevation of 0.2 mV or less was required for STEMI in the ECG. In the absence of STEMI criteria, new horizontal or down-sloping ST depression 0.05 mV in two adjacent leads or T-wave inversion 0.1 mV in two adjacent leads with strong R wave or R/S ratio >1 or both were judged to be confirmed ischemia abnormalities [(6)].

ECG interpretations included (I) no ischemia changes, (II) infarction if STEMI criteria were satisfied and (III) definite ischemic ECG abnormalities in the absence of STEMI criteria in the anterior (V1–V4), inferior (II, III, aVF), lateral (V5–V7) or heart regions (I, aVL, V5, V6) [(7)].

Echocardiography (ECHO):

To analyze and report the function of the left ventricle using Phillips HD7 machine and a probe S4. We performed a transthoracic echocardiogram within 2-3 days of admitting the patient. LV functions are based on these results. Modified Simpson's approach was used to determine heart rate synchrony. The American Society of Echocardiography's guidelines for recording and calculating various parameters were followed [(8)]. EF was calculated using 2D volume measurements, the biplane Simpson's approach, as the primary output. When viewing the left ventricle from the top, researchers looked at the volumes in the apical four chambers (A4C), as well as the top two chambers (A2C). As the frame with the smallest cavity area, end systole was chosen, and as the frame with the largest LV cavity area, end diastole was chosen. For each view, the EF (percent) was determined using the formula: EF = [(EDV - ESV)/EDV] by 100 times [(8)].

Laboratory tests:

- LDL-C, HDL-C, triglycerides, glycerol oxidase, and non-HDL-C lipid profiles were all measured using the autoanalyzer, along with total cholesterol, HDL-C, immunoinhibition, and non-HDL-C triglycerides [(9)].
- Glycosylated hemoglobin (HbA1c) test.
- Fasting and 2-hour postprandial blood glucose level.

Coronary angiography:

Coronary angiography was performed by the Judkins technique without nitroglycerin using 6-French right and left heart catheters to assess condition of epicardial arteries and their lesions [(9)]. Clinical state and laboratory measures had no bearing on how the interventional cardiologists evaluated the angiograms. Two cardiologists independently interpreted each angiogram after it had been obtained using normal methods [(4)]. Multiple projections of coronary angiography were used to properly analyse the target lesions [(2)].

The percentage of luminal diameter stenosis in the coronary arteries was calculated by visually estimating the degree of constriction. In patients with LAD, circumflex artery, right coronary or major branch constriction of 70 percent and 50 percent of the left main coronary artery. Severe angiographic artery disease was identified [(3)].

Gensini score:

A common grading method in cardiovascular medicine is the Gensini score, which considers factors such as location, degree of luminal constriction, and the overall effect of various blockages. The reduction in lumen diameter indicates the severity of stenosis, and each lesion is given a nonlinear score based on it. This score is calculated by adding together all of the lesion scores.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

Revision, coding and tabulation of the gathered data were completed on a PC with the help of the Statistical package for Social Science (SPSS version 20.0 for windows; SPSS Inc, Chicago, IL, 2001). Presented data had been subjected to appropriate analysis based on the type of data collected for each parameter. T test revealed differences between two sets of quantitatively independent samples. For statistically significant results, the P value was set at equal or less than 0.05, and for very significant results, it was set at 0.001.

RESULTS

Age was distributed as 60.01 ± 8.41 and 58.92 ± 7.38 years between No-CAD and CAD respectively without significant difference between groups. Regarding sex distribution, male were significantly associated with CAD cases (Table 1).

CAD group were significantly higher regarding BMI as it was distributed as 28.77 ± 2.3 and 30.04 ± 3.03 between No-CAD and CAD respectively (Table 2). There was no significant difference or association between smoking or hypertension and CAD (Table 3).

SBP and DBP were significantly higher among CAD (Table 4). Fasting blood glucose and HbA1c were significantly higher among CAD group than No-CAD group (Table 5). Regarding TG and LDL-C distribution, CAD group were significantly higher than No-CAD group (Table 6). CAD group were significantly associated with abnormal finding regarding echocardiographic parameters (Table 7).

Table (1): Age and sex distribution among studied group

			No-CAD	CAD	P
Age			**60.01 ± 8.41**	**58.92 ± 7.38**	**0.418**
Sex	**Male**	**N**	**31**	**50**	**0.001****
		%	**44.3%**	**71.4%**	
	Female	**N**	**39**	**20**	
		%	**55.7%**	**28.6%**	
Total		**N**	**70**	**70**	
		%	**100.0%**	**100.0%**	

Table (2): BMI distribution between studied groups

	No-CAD	CAD	T	P
BMI (kg/m^2)	**28.77 ± 2.3**	**30.04 ± 3.03**	**-2.788**	**0.006***

Table (3): Risk factors distribution between studied groups

			Group		Total	P
			No-CAD	CAD		
Smoker	**Not**	**N**	37	34	71	0.61
		%	52.9%	48.6%	50.7%	
	Smoker	**N**	33	36	69	
		%	47.1%	51.4%	49.3%	
Hypertension	**No**	**N**	27	25	52	0.72
		%	38.6%	35.7%	37.1%	
	HTN	**N**	43	45	88	
		%	61.4%	64.3%	62.9%	
Total		**N**	70	70	140	
		%	100.0%	100.0%	100.0%	

Table (4): Vital data distribution between studied groups

	No-CAD	CAD	t	P
SBP (mmHg)	126.92 ± 11.55	131.5 ± 11.55	-2.340	0.021*
DBP (mmHg)	83.28 ± 8.29	86.0 ± 7.59	-2.020	0.045*
HR (beats/minute)	76.9 ± 12.03	75.47 ± 12.11	0.700	0.485

Table (5): FBG, 2H post prandial and HA1C distribution between groups

	No-CAD	CAD	t	P
Fasting glucose (mg/dl)	166.98 ± 9.02	216.9 ± 6.63	-5.595	0.00**
2H post prandial (mg/dl)	241.74 ± 56.94	232.82 ± 58.97	0.910	0.365
HbA1c (%)	6.81 ± 1.2	7.5 ± 1.59	-2.901	0.004*

Table (6): Lipid profile distribution between studied groups

	No-CAD	CAD	t	P
TG mos/ml	5.21 ± 1.8	12.46 ± 2.1	-7.563	0.00**
HDL mos/ml	1.98 ± 0.07	1.82 ± 0.09	0.740	0.460
LDL (mg/dl)	126.82 ± 12.91	156.17 ± 17.9	-11.118	0.00**

Table (7): ECHO finding distribution between studied groups.

			Group		Total	P
			No-CAD	CAD		
ECHO	**Normal**	**N**	**33**	**5**	**38**	**0.00****
		%	**47.1%**	**7.1%**	**27.1%**	
	Abnormal finding	**N**	**37**	**65**	**102**	
		%	**52.9%**	**92.9%**	**72.9%**	
Total		**N**	**70**	**70**	**140**	
		%	**100.0%**	**100.0%**	**100.0%**	

DISCUSSION

Type 2 diabetes mellitus individuals are at increased risk of cardiovascular illness and death due to cardiovascular diseases such as coronary artery disease (CAD). Diabetic complications such as insulin resistance, dyslipidemia, erectile dysfunction (ED), and vascular inflammation are common in people with type 2 diabetes. There is a strong correlation between each of these abnormalities and an increased risk of developing cardiovascular disease [(10)].

In diabetes mellitus, the most common consequence is dyslipidaemia, which is characterised by high cholesterol. Atherogenic variables in patients with type 2 diabetes mellitus included hypertriglyceridaemia, reduced HDL-C, and elevated LDL-C. Diabetes mellitus and insulin resistance are the main causes of dyslipidaemia [(11)].

HbA1c, fasting and/or postprandial hyperglycemia were found to influence cardiovascular complication incidence, whether these variables were studied concurrently or independently [(12)].

In our study, age was distributed as 60.01 ± 8.41 and 58.92 ± 7.38 years between No-CAD and CAD respectively without significant difference between the two groups. **Wei *et al.*** [(13)] reported that elderly patients have the most severe form of CAD, they have more complex coronaries, and they have multivessel coronary artery lesions. In the United Kingdom, coronary artery disease is a leading source of morbidity and mortality with an estimated 80,000 fatalities each year, with more than half of those deaths occurring in patients 75 years of age or older. More research suggests that age-related deterioration of the processes that control coronary artery flow may possibly play a role [(14)].

Regarding sex distribution, males were significantly associated with CAD cases. This is in agreement with **Ghem *et al.*** [(15)] research that revealed an increased risk of severe coronary atherosclerosis in men. This could be because the study's sample size was primarily male. But, **Turfana *et al.*** [(16)] reported that there was no discernible difference in the severity of CAD between the sexes.

In our study, CAD group was significantly higher regarding BMI, as it was distributed as 28.77 ± 2.3 and 30.04 ± 3.03 between No-CAD and CAD respectively. **Palem and Abraham** [(17)] discovered that type 2 diabetics had significantly higher BMIs than healthy controls.

Regarding smoking in our study, 71 patients (50.7%) were non-smokers, and 69 patients (49.3%) were smokers, with no significant difference or association between smoking and CAD. This is in agreement with **Turfana *et al.*** [(16)] who reported that the severity of coronary artery disease was found to be the same whether you smoked or not, and this might be explained by the fact that they included all individuals who had smoked in the past without making a distinction between former smokers and present smokers. While, a healthy endothelium defends against vascular injuries, various mechanisms such as platelet aggregation, adhesion, inflammatory cell migration, and lipid precipitation occur when this structure loses its integrity and becomes thrombogenic. These variables are also brought on by the nicotine in cigarettes activating the adrenergic and sympathetic nervous systems [(18)].

Regarding hypertension in our study, 88 patients (62.9%) had hypertension, with no significant difference or association between hypertension and CAD**.** In **Su *et al.*** [(12)] study**,** diabetics with CAD were found to be older, more male, and cigarette smokers than diabetics without CAD.

Multiple mechanisms, including hyperglycemia-induced increases in oxidative stress, endothelial dysfunction, renal function–induced mineral metabolism changes, and increased circulating inflammatory cytokine production, all play a role in the development of vessel calcification in people with diabetes [(19)]. There is evidence to back up the theory that having a severe form of coronary artery disease makes you more likely to get diabetes.

In our study, SBP and DBP were significantly higher among CAD patients. But, **Yu *et al.*** [(20)] discovered that even with higher systolic and diastolic blood pressure, coronary artery disease remained the same in complexity or severity.

In our study, fasting blood glucose and HbA1c were significantly higher among CAD group than No-CAD group. **Su *et al.*** [(12)] reported that individuals with CAD had significantly larger mean amplitude glycemic excursions (MAGE) and postprandial glucose excursions (PPGE) than those without CAD.

In our study, CAD group was significantly higher regarding TG and LDL-C distribution than No-CAD group. **Kumawat *et al.*** [(21)] reported that patients with type 2 diabetes had considerably higher triglyceride and VLDL-C, and lower HDL cholesterol levels than healthy controls. In **Gupta and Chari** [(22)] study on diabetic individuals with ischemic heart disease (IHD), they found considerably higher LDL cholesterol, total cholesterol, triglyceride and VLDL cholesterol, and lower HDL cholesterol than diabetics who did not have other comorbidities.

According to **the American Diabetic Association (ADA)** [(23)]**,** the greatest predictors of CVD were elevated triglycerides and lower HDL-C values. LDL cholesterol is a powerful predictor of cardiovascular disease in diabetics, according to **Howard *et al.*** [(24)] research. However, **Garg *et al.*** [(25)] found that TC/HDL and LDL/HDL ratios are better indicators of CAD than only looking at the amounts of TC, TG, LDL-C, and HDL cholesterol alone . **Palem and Abraham** [(17)] reported that type 2 diabetes participants had considerably higher TG, LDL-C, and VLDL-C values than healthy controls. TC and HDL-C levels, on the other hand, did not differ significantly between the research groups.

In our study, CAD group was significantly associated with abnormal echocardiographic findings and Gensini score. It's well-known that high blood sugar in diabetics leads to a variety of health problems including dyslipidemia, oxidative stress, erectile dysfunction, and an increased risk of cardiovascular disease [17].

CONCLUSION

Increased triglycerides and decreased HDL-C levels were associated with CVD among diabetic patients.

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REFERENCES

1. **Benjamin E, Blaha M, Chiuve S *et al.* (2017):** Heart disease and stroke statistics-2017 update: a report from the American Heart Association. Circulation, 135: 146–603.
2. **Ashley E, Myers J, Froelicher V *et al.* (2000):** Exercise testing in clinical medicine. Lancet, 356: 1592–7.
3. **Ramen C, Manas B, Asarma P *et al.* (2013):** An overview on management of diabetic dyslipidemia. Journal of Diabetes and Endocrinology, 4 (3): 27-36.
4. **Mohammad A, Jehamgeer H, Khalif S *et al.* (2015):** Prevalence and risk factors of premature coronary artery disease in patients undergoing coronary angiography in Kurdistan. Iraq BMC Cardiovascular Disorders, 15: 155-158.
5. **Kontush H (2015):** Particle number and size as predictors of cardiovascular disease. Front Pharmacol., 6: 218-222.
6. **Thygesen K, Alpert J, Jaffe A *et al.* (2012):** Third universal definition of myocardial infarction. Circulation, 126: 2020-35.
7. **Austen W, Edwards J, Frye R *et al.* (1975):** A reporting system on patients evaluated for coronary artery disease. Circulation, 51: 5-40.
8. **Lang R, Badano L, Mor-Avi V *et al.* (2015):** Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. European Heart Journal-Cardiovascular Imaging, 16 (3): 233-71.
9. **Viera A, Neutze D (2010):** Diagnosis of secondary hypertension: an age-based approach. Am Fam Physician, 82 (12): 1471–8.
10. **Kendall D, Rubin C, Mohideen P *et al.* (2006):** Improvement of glycemic control, triglycerides, and HDL cholesterol levels with muraglitazar, a dual (α/g) peroxisome proliferator–activated receptor activator, in patients with type 2 diabetes inadequately controlled with metformin monotherapy. Diabetes Care, 29 (5): 1016-23.
11. **Toledo F, Sniderman A, Kelley D *et al.* (2006):** Influence of hepatic steatosis (fatty liver) on severity and composition of dyslipidaemia in type 2 diabetes. Diabetes Care, 29 (8): 1845-50.
12. **Su G, Mi S, Tao H *et al.* (2011):** Association of glycemic variability and the presence and severity of coronary artery disease in patients with type 2 diabetes. Cardiovascular Diabetology, 10: 19-23.
13. **Wei S, Gao C, Wei G *et al.* (2012):** The level of serum bilirubin associated with coronary lesion types in patients with coronary artery disease. J Cardiovasc Med (Hagerstown), 13 (7): 432-438.
14. **Shah M, Sikkel M (2013):** Coronary artery disease and age: beyond atherosclerosis. J Physiol., 591 (23): 5807-5808.
15. **Ghem C, Sarmento-Leite R, de Quadros A *et al.* (2010):** Serum bilirubin concentration in patients with an established coronary artery disease. Int Heart J., 51 (2): 86-91.
16. **Turfana M, Duranb M, Poyrazc F *et al.* (2013):** Inverse relationship between serum total bilirubin levels and severity of disease in patients with stable coronary artery disease. Coronary Artery Disease, 3: 29-32.
17. **Henry R (2001):** Preventing cardiovascular complications of type 2 diabetes: focus on lipid management. Clin Diabetes, 19 (3): 113-20.
18. **Anogeianaki A, Angelucci D, Cianchetti E *et al.* (2011):** Atherosclerosis: a classic inflammatory disease. Int J Immunopathol Pharmacol., 24 (4): 817-825.
19. **Nozue T, Yamamoto S, Tohyama S *et al.*** (2012): Impact of diabetes mellitus on coronary atherosclerosis and plaque composition under statin therapy - subanalysis of the TRUTH study. Circ J., 76 (9): 2188-2196.
20. **Yu J, Han J, Wang G *et al.* (2016):** Serum total bilirubin levels and disease severity in patients with stable coronary artery disease. https://www.researchgate.net/publication/308925539_Serum_total_bilirubin_levels_and_disease_severity_in_patients_with_stable_coronary_artery_disease
21. **Kumawat M, Sharma T, Singh I *et al.* (2013):** Antioxidant enzymes and lipid peroxidation in type 2 diabetes mellitus patients with and without nephropathy. N Am J Med Sci., 5 (3): 213-19.
22. **Gupta M, Chari S (2006):** Proxidant and antioxidant status in patients of type II diabetes mellitus with IHD. Indian J Clin Biochem., 21 (2): 118-22.
23. **American Diabetic Association (1998):** Pathogenesis. In: Medical Management of Type 2 Diabetes, 4th ed. Zimmerman BR, Ed. Alexandria, Va., American Diabetic Association, Pp: 19-26.
24. **Howard B, Robbins D, Sievers M *et al.* (2000):** LDL cholesterol as a strong predictor of coronary heart disease in diabetic individuals with insulin resistance and low LDL: the strong heart study. Arterioscler Thromb Vasc Biol., 20 (3): 830-35.
25. **Garg N, Agrawal Y, Gupta S (2014):** Study of lipid profile levels in diabetics and nondiabetics taking TC/HDL ratio and LDL/HDL ratio into consideration. J Indian Assoc Clin Med., 15 (3-4): 192-95.