

A STUDY OF SERUM MALONDIALDEHYDE (MDA) LEVELS IN PATIENTS OF ACUTE CORONARY SYNDROME WITH TYPE 2 DIABETES MELLITUS AND TYPE 2 DIABETES MELLITUS PATIENTS WITHOUT ACUTE CORONARY SYNDROME

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Abstract

Diabetes mellitus is a metabolic disorder characterized by hyperglycemia due to impaired insulin response or insulin secretion. Malondialdehyde (MDA) is an end product of lipid peroxidation, noted to be significantly increased in type 2 diabetes which cause atherosclerotic lesions. The aim of this study is to find serum malondialdehyde (MDA) levels in patients of acute coronary syndrome with type 2 diabetes mellitus and type 2 diabetes mellitus patients without acute coronary syndrome (ACS). A total of 212 patients with T2DM from the Saveetha Medical College and hospital's General Medicine department were enrolled in the study. There were 106 individuals with Type 2 DM without Acute coronary syndrome and another 106 patients with Type 2 DM with Acute coronary syndrome. Duration of diabetes Mellitus, Total cholesterol, elevated TAG, Elevated LDL, low HDL were significantly associated with the development of acute coronary syndrome among diabetic patients. The mean Serum MDA among the participants in the T2DM with Acute coronary syndrome was 3.90 ± 0.44 mg/dl while among those in the T2DM without Acute coronary syndrome was 1.98 ± 0.45 mg/dl. With a P value of less than 0.05, it was discovered that the mean serum MDA was significantly higher in the T2DM with Acute coronary syndrome group than the T2DM without Acute coronary syndrome group. The traditional Cardiovascular disease risk factors including diabetes, hypertension, hyperlipidemia, and cigarette smoking are strongly linked with higher MDA levels.

Keywords: Malondialdehyde, Acute Coronary Syndrome, Diabetes, Hyperglycemia.

INTRODUCTION

Diabetes mellitus is a metabolic disorder characterized by hyperglycaemia due to impaired insulin response or insulin secretion (1). These metabolic disorders may cause cellular changes and increased risk of atherosclerotic cardiovascular disease (2). Malondialdehyde (MDA) is an end product of lipid peroxidation, noted to be significantly increased in type 2 diabetes which cause atherosclerotic lesions (3). Cardiovascular disease in type 2 diabetes mellitus is a major cause of mortality and morbidity. Though many factors causing progression of atherosclerosis, elevated LDL cholesterol levels is the major cause for atherosclerosis. Smoking, impaired glucose tolerance, obesity are the additional causes for atherosclerosis (4). In atherosclerosis

there is macrophages infiltration in arterial intima causing thick plaques that narrows the artery results in cardiovascular disease (5).

Malondialdehyde (MDA) interacts reversibly or irreversibly with the proteins and phospholipids resulting in harmful effects. Malondialdehyde causes stiffness of collagen fibers in cardiovascular system and also results in increased resistant to remodeling (6). Malondialdehyde is used as a putative of lipid oxidation in arterial lesions. Recently research showed that both oxidized low density lipoprotein (ox-LDL) and Malondialdehyde seen in the atherosclerotic plaque (7). However, there is still a debate on the relation between the MDA levels and type 2 diabetes duration (8,9).

Malondialdehyde-modified low-density lipoprotein is one of the primary results of lipid peroxidation and the primary source of oxidised LDL (MDA-LDL). MDA-LDL, like oxidised LDL, has been shown in numerous studies to be an important marker for indicating the severity of cardiovascular disease. MDA-LDL levels are also a predictor of stent restenosis in patients with type-2 diabetes who have had a prior myocardial infarction or stable angina pectoris following PCI.

Various studies conducted over the past three decades have shown a correlation between elevated MDA levels and CVD. There is proof that traditional CVD risk factors including diabetes, hypertension, hyperlipidemia, and cigarette smoking are strongly linked with higher MDA levels.

METHODS AND MATERIALS

This cross-sectional study was conducted at the General Medicine department of Saveetha Medical College and Hospital. A total of 212 patients diagnosed with type 2 diabetes mellitus (T2DM) were enrolled.

They were divided into two groups: 106 patients with T2DM without acute coronary syndrome (ACS) and 106 patients with T2DM with ACS.

Inclusion Criteria: Patients aged 18 years or older with confirmed diagnosis of T2DM were eligible for inclusion.

Exclusion Criteria: Patients with history of endocrine diseases, alcohol consumption, smoking, antioxidant supplement usage, hepatic diseases, and severe renal impairment were excluded from the study.

Data Collection: Complete medical history and clinical examination were conducted for all patients.

Laboratory investigations included: Blood pressure measurement, Fasting blood glucose level assessment, Glycated hemoglobin (HbA1C) measurement, Total cholesterol level determination, Serum triglyceride level assessment, High-density lipoprotein (HDL) cholesterol measurement, Low-density lipoprotein (LDL) cholesterol measurement, Serum creatinine level determination, Measurement of serum malondialdehyde (MDA) levels.

Statistical Analysis: Descriptive statistics were used to summarize patient characteristics. Student's t-test or Mann-Whitney U test was employed to compare continuous variables between groups, while chi-square test was used for categorical variables. A p-value < 0.05 was considered statistically significant.

Ethical Considerations: The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the institutional review board

RESULTS

Comparison between Serum MDA level and ACS

Table 1: Comparison of mean Serum MDA between T2DM with ACS and T2DM without ACS

Variable	Acute coronary syndrome (Mean (SD))			
	Yes(n=106)	No(n=106)	T test statistic	P Value
Serum MDA (nmol/ml)	3.9(0.44)	2(0.5)	31.3	0.000*

The mean Serum MDA among the participants in the T2DM with ACS was 3.90 ± 0.44 mg/dl while among those in the T2DM without ACS was 1.98 ± 0.45 mg/dl. With a P value of less than 0.05, it was discovered that the mean serum MDA was significantly higher in the T2DM with ACS group than the T2DM without ACS group.

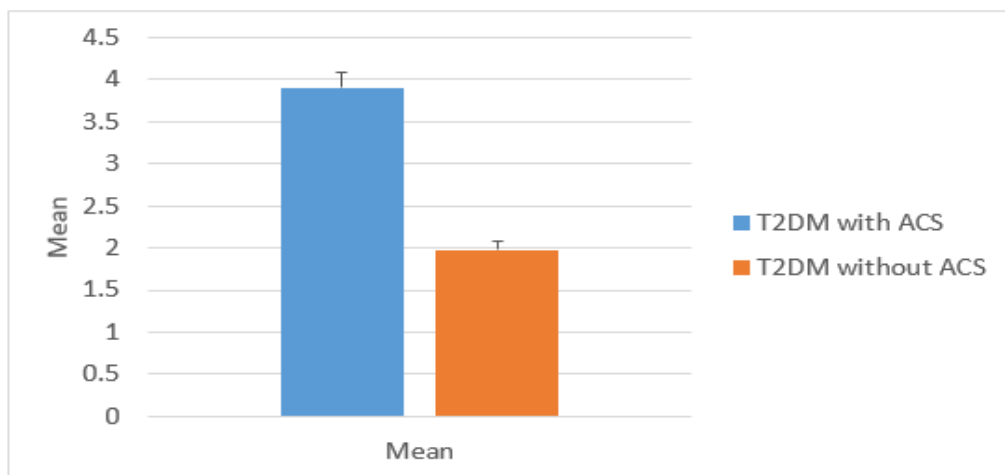


Fig 1: Bar chart showing comparison of mean Serum MDA in patients of T2DM with ACS and T2DM without ACS

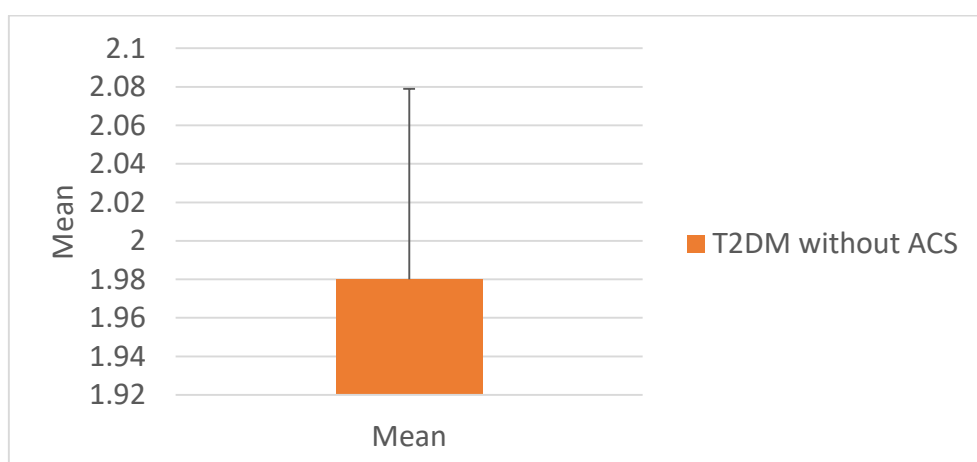


Table 2: Comparison of MDA levels and Acute coronary syndrome

MDA level	T2DM with ACS(n=106)		UA (n=25)	T2DM without ACS
	NSTEMI (n=37)	STEMI (n=44)		T2DM without ACS (n=106)
Normal (1.6 nmol/ml and below)	0	0	0	17(16%)
High (>1.6nmol/ml)	37(34.9%)	44(41.5%)	25(23.6%)	89 (84%)

All the T2DM patients with ACS had high MDA level (100%) whereas 84 % of the T2DM patients without ACS had high MDA levels.

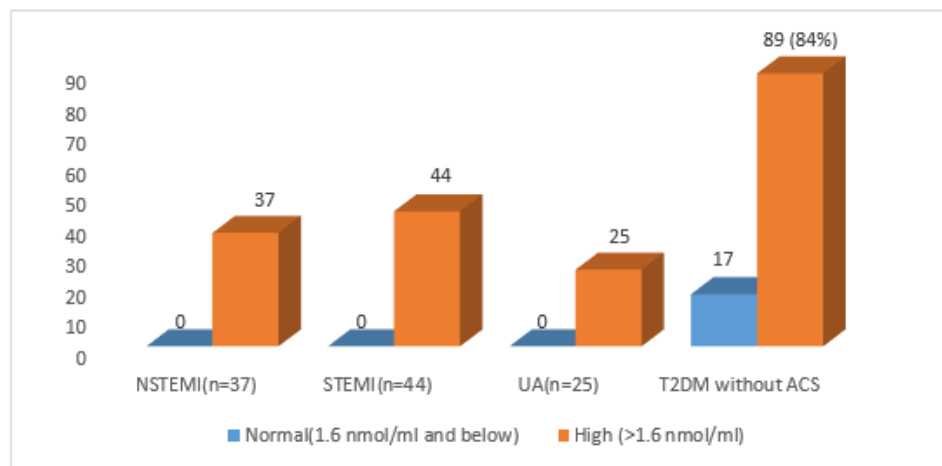


Figure 2: Bar chart showing comparison of MDA levels and Acute coronary syndrome types

Table 3: Comparison of mean MDA levels and Acute coronary syndrome

Variable	Acute coronary syndrome			F statistic	P Value
	NSTEMI(n=37)	STEMI(n=44)	UA(n=25)		
Serum MDA level (Mean (SD))	3.8086 (0.15)	4.2718(0.3)	3.3916(0.3)	495	0.000*

Significant difference exists in the mean MDA levels and it is more higher in more severe forms.

Table 4: Bivariate analysis: Risk factors of acute coronary syndrome in diabetic patients

Variable	Category	Acute coronary syndrome (Mean (SD))		Odds ratio(95 % CI)	P Value
		Yes(n=106)	No(n=106)		
Age (yrs)	59 years and above	52(50.5%)	51(49.5%)	1.04(0.6 to 1.8)	0.89
	<59 years	54(49.5%)	55(50.5%)		
Sex	Female	53(50.5%)	52(49.5%)	1.04(0.6 to 1.8)	0.89
	Male	53(49.5%)	54(50.5%)		
Duration of Diabetes Mellitus (yrs)	>8 years	96(89.7%)	11(10.3%)	82.9(33.6 to 204.4)	<0.00001*
	8 years and below	10(9.5%)	95(90.5%)		
Hypertension	Yes	21(41.7%)	14*(53.3%)	0.94(0.5 to 1.8)	0.9
	No	85(48%)	92(52%)		

Glycemic control	Poor(HbA1C 7% and above)	106(55.2%)	86(44.8%)		<0.00001*
	Good(HbA1C <7%)	0	20(100%)		
Total cholesterol (mg/dl)	Elevated (200 mg/dl) and above)	25(69.4%)	11(30.6%)	2.7(1.2 to 5.7)	0.01*
	Normal(<200mg/dl)	81(46%)	95(54%)		
Serum triglyceride (mg/dl)	Elevated (150 mg/dl) and above)	24(66.7%)	12(33.3%)	2.3 (1 to 4.9)	0.03*
	Normal(<150mg/dl)	82(46.6%)	94(53.4%)		
HDL (mg/dl)	Low<45 mg/dl)	25(69.4%)	11(30.6%)	2.7 (1.2 to 5.7)	0.01*
	Normal(45 mg/dl and above)	81(46%)	95(54%)		
LDL (mg/dl)	Elevated (100 mg/dl) and above)	25(69.4%)	11(30.6%)	2.7 (1.2 to 5.7)	0.01*
	Normal(<100mg/dl)	81(46%)	95(54%)		
Serum MDA (nmol/ml)	High (>1.6)	0	17(100%)		<0.00001*
	Normal (1.6 and below)	106(57.3%)	89(45.6%)		

Duration of diabetes Mellitus (more than 8 years), Total cholesterol, elevated TAG, Elevated LDL and low HDL had 82 times, 2.7 times, 2.3 times, 2.7 times and 2.7 times more odds of developing acute coronary syndrome among diabetic patients respectively. It is statistically significant ($p < 0.05$).

DISCUSSION

Malondialdehyde is an important risk factor for cardiovascular diseases. Mc Murray conducted a study to find the concentration of MDA in patients with type 2 diabetes mellitus (DM2) and patients with coronary disease and noted an increased level of malondialdehyde in coronary artery patients. M Rábago-Velasco et al found increased plasma MDA and considered as a biochemical marker for cardiovascular disease. The author suggests MDA levels greater than 62.7 mgm/dl is an important risk factor for myocardial infarction [10]. Recent studies showed that the MDA-LDL levels are positively correlated with LDL-C and triglyceride levels and negatively correlated with HDL-C levels [11].

In our present study, we noted that there mean serum MDA was significantly higher in the T2DM with ACS group than the T2DM without ACS group. The lipid profile of the patients showed triglyceride and HDL-C in poor control group was higher than in good control group. In another study noted that there is a significant relationship between

HbA1c and dyslipidemia and serum triglyceride. The triglyceride increased levels produced reduced lipoprotein lipase activity in hyperglycemic patients [12].

When correlating serum MDA levels to lipid profile parameters in the diabetic group, found that significant positive correlation to TC, TG, and LDL in our study which was similar to findings by Tangvarasittichai et al [13] and Hamad et al. (2009) [14].

Multivariate analysis found that the urinary MDA and glycemic control have a relation with type 2 diabetes mellitus. HDL-C, triglyceride, and FBS levels, Glycemic control are correlated between urinary Malonaldehyde and glycemic control in our T2DM patients.

In our study, we noted that the duration of diabetes Mellitus, Total cholesterol, elevated TAG, Elevated LDL, low HDL were significantly associated with the development of acute coronary syndrome among diabetic patients. Duration of diabetes Mellitus (more than 8 years), Total cholesterol, elevated TAG, Elevated LDL and low HDL had 82 times, 2.7 times, 2.3 times, 2.7 times, and 2.7 times more odds of developing acute coronary syndrome among diabetic patients respectively. It is statistically significant ($p < 0.05$).

CONCLUSION

Serum MDA levels are increased in both groups but the elevation was much higher in T2DM with ACS group which reveals the importance of serum Malondialdehyde as an oxidative stress marker which starts to increase early during the course of T2DM. The study indicates serum MDA level as a good predictor of Acute coronary syndrome. Duration of diabetes Mellitus, Total cholesterol, elevated TAG, Elevated LDL, low HDL were significantly associated with the development of acute coronary syndrome among diabetic patients. Thus our study shows that estimation of serum Malondialdehyde levels helps in early detection of atherosclerosis in Type 2 Diabetes Mellitus patients and can help to reduce the extent of damage.

In our study, the patients with type 2 diabetes with or without ACS compared to initial stages of diabetes in severe or uncontrolled form of diabetes or diabetes with complications, MDA is more raised and definitely raised in patients with ACS. Serum MDA-LDL levels could be an important predictor of future cardiac events.

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