

Original Research Article

A study on serum lipid and malondialdehyde levels among diabetic patients

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ABSTRACT

Background: Elevated levels of lipid peroxide in diabetes mellitus may be due to the alteration of function of erythrocytes membrane. This inhibits the activity of superoxide dismutase enzyme leading to accumulation of superoxide radicals which cause the maximum lipid peroxidation and tissue damage in diabetes. The objectives was to study was done with the objectives of assessing the serum lipid and malondialdehyde levels among diabetic population and matched control group.

Methods: This study was done among 50 NIDDM, 50 IDDM and 50 controls at Thanjavur Medical College, Tamil Nadu, India for a period of one year at the Department of Diabetology after getting the informed consent and IEC clearance. This study included all ambulatory NIDDM and IDDM patients without any complications. The following investigations like serum malondialdehyde, blood sugar, HBA1C, serum lipid profile, blood urea, serum creatinine, urine albumin and sugar were done by standardized procedures and reagents after getting the detailed history and examination.

Results: Among NIDDM group 78% were between 6.4 to 8 categories whereas in IDDM group only 28% were in this 6.4 to 8 category (HBA1C). Comparison of serum MDA values among three groups were done by ANOVA with two groups separately and it was highly significant. Multiple comparison of mean difference of MDA and lipid values among all the three groups showed statistically significant results with p value at 0.05.

Conclusions: Lipid profile is increased in poor glycemic controlled patients (both IDDM and NIDDM patients) and it is reflected in high serum malondialdehyde levels.

Keywords: Glycemic status, HBA1C, IDDM, NIDDM, Serum lipid levels, Serum malondialdehyde

INTRODUCTION

Diabetes mellitus is a group of metabolic disease characterized by hyperglycaemia resulting from defects in Insulin secretion, Insulin action or both.¹ It is a complex disease where carbohydrate, protein and fat

metabolism is impaired. Diabetes is an “ice berg” disease. The number of cases of diabetes worldwide is estimated to be around 150 million. It is estimated that 20 percent of the current global diabetic population resides in South-East Asia Region. In India, the prevalence of disease in adults was found to be 2-4 percent in rural and 4-11.6 percent in urban dwellers. High frequencies of impaired

glucose tolerance, shown by studies ranging from 3.6-9.1 percent indicate the potential for further rise in prevalence of DM in the coming decades.³

Classification⁴

- Type 1 Diabetes
 - Immune mediated,
 - Idiopathic.
- Type 2 Diabetes
 - Other specific types,
 - Gestational Diabetes Mellitus (GDM),
 - Impaired Glucose Tolerance (IGT).

IDDM onset is typically abrupt and is usually seen in individual less than 30 years.⁵ Immune mediated and β cells of pancreas are destroyed, usually associated with ketosis, Exogenous insulin is required to reverse the catabolic state. NIDDM is more common than IDDM, gradual in onset and occurs mainly in the middle aged and elderly.³

Diabetes is better known for its complications affecting the vascular system, kidney, retina, lens, peripheral nerves and skin which are extremely costly in terms of longevity and quality of life.⁶

Lipid peroxidation is elevated in Diabetes.⁷ Diabetes is usually accompanied by increased production of free radicals or reactive oxygen species which produces oxidative stress.⁷ The occurrence of free radical induced lipid peroxidation causes considerable change in the cell membrane.⁸ Peroxidation of lipid membrane has been related to the pathogenesis of many degenerative diseases such as atherosclerosis.⁹ Atherosclerosis is the most common complication of diabetes.¹⁰

Free radicals damage lipids by initiating a process called lipid peroxidation.¹¹

The decomposition of lipid peroxides forms many cytotoxic compounds like malondialdehyde (MDA).

So, oxidative stress can be measured by monitoring the changes in malondialdehyde.^{6,7} Degree of lipid peroxidation was measured in terms of MDA.

The objectives were to assess the level of lipid peroxide among diabetic patients and to find out the correlation between lipid peroxide with glycaemic control (HBA1C).

METHODS

Participants of the study group were selected from the outpatient's population of Department of Diabetology, Thanjavur Medical College, Thanjavur, Tamil Nadu, India. 100 patients were selected for this study. Out of which 50 patients belong to NIDDM and 50 to IDDM group. 50 persons served as healthy control. Informed

consent was obtained before starting the study and IEC clearance was also. obtained.

Inclusion criteria

All ambulatory NIDDM and IDDM patients without any complications.

Exclusion criteria

Smokers, alcoholics, renal failure, bronchial asthma, history suggestive of complications of DM (angiopathy, cardiopathy, retinopathy, nephropathy).

Procedure

Detailed history and complete clinical examination were done in all the cases. For all the patients, fasting and post prandial blood samples and fasting urine samples were collected. For blood sugar estimation, blood collected in fluorinated tube. For other investigations in plain tube samples were collected. The following investigations like serum malondialdehyde, Blood sugar (fasting and post prandial), HbA1C, serum lipid profile, blood urea, serum creatinine, urine albumin and sugar. All the procedures for measurements of above biochemical values were done using standardized reagents and instruments.

Appropriate statistical methods like descriptive statistics, chi-square tests and ANOVA were applied using SPSS software version 20.

RESULTS

Totally 150 study participants were studied of which 50 from NIDDM, 50 from IDDM and 50 as controls. Majority were from 30 to 50 years age group with equal number of males and females and 90% of the study participants in all the three groups had BMI between 18 to 25 categories. Glycemic status with HBA1C values classified between less than 6.4, 6.5 to 8 and more than 8. Among NIDDM group 78% were between 6.4 to 8 categories whereas in IDDM group only 28% were in these 6.4 to 8 categories.

Serum malondialdehyde result analysis

Comparison of serum MDA values among three groups were done by ANOVA with two groups separately shown in Tables 1 and 2 and it was highly significant. The difference of MDA values is more pronounced among control and diabetic groups of patients ($p < 0.0001$). Similarly, the MDA mean values among IDDM and NIDDM also showed the significant difference but not much in control group. Multiple comparison of mean difference of MDA values among all the three groups control, NIDDM and IDDM simultaneously showed significant results with p value at 0.05 (Table 3).

Table 1: MDA in different groups.

Descriptive statistics	Control	Diabetic	P value
Mean	3.25	5.31	p <0.0001
SD	0.53	0.58	

Table 2: MDA in different diabetic groups.

Descriptive statistics	IDDM	NIIDDM	P value
Mean	4.95	5.68	p=0.003
SD	0.61	0.55	

Table 3: Multiple comparison table of three groups.

Study groups		Mean Difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
Control	IDDM	-1.254*	0.101	0.001	-1.50	-1.01
	NIIDDM	-1.233*	0.101	0.003	-1.48	-.99
IDDM	Control	1.254*	0.101	0.002	1.01	1.50
	NIIDDM	0.020	0.101	0.03	-.22	.27
NIIDDM	Control	1.233*	0.101	0.001	.99	1.48
	IDDM	-.020	0.101	0.04	-.27	.22

The statistical test between three groups in Table 3 showed the mean difference was 1.233 with the 95% CI range between 0.99 to 1.48 with highly significance. This clinically correlates with the poor glycaemic control among diabetes patient's high values of MDA than the control group (p <0.001).

The scatter plot between serum lipid levels and HbA1c levels shows that both the variables are mutually increasing as the HbA1c levels are more than 7 which suggests that the lipid levels are affected by the glycaemic status among diabetic individuals.

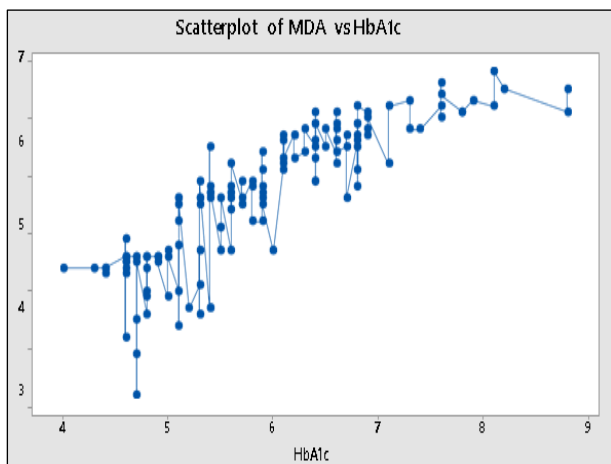


Figure 1: Comparison of serum malondialdehyde and glycaemic status.

Figure 1 depicts the correlation diagram between HbA1c values and the serum MDA levels. As the glycaemic status increases among the group of patients the MDA values also increase which shows that the glycaemic status correlates with the MDA values.

Figure 2 depicts the TC levels with the glycaemic status (HbA1c), predicts the relationship between both the variables. When the patients are going in for poor glycaemic control the lipid peroxidation metabolite that is MDA and total cholesterol values increase which is the predictor for poor glycaemic status among diabetic patients.

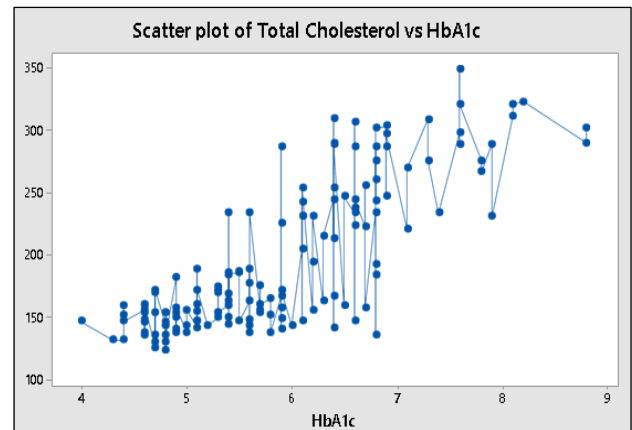


Figure 2: Glycaemic status vs lipid profile.

So, both the MDA levels and the TC levels increase as the HbA1c levels increase which shows positive correlation in this study.

DISCUSSION

The mean value of plasma MDA is high in diabetic patients when compared to control group. Increased lipid peroxidation in diabetes mellitus is due to excess formation of free radicals.¹² Hyperglycaemia in diabetics causes increased glycation of protein which itself act as a source of free radicals. Metabolic derangements in

diabetes lead to an increase in concentration of oxidizable substrates and compromised detoxification pathways. The study shows that cases on insulin as therapeutic regime (IDDM) had lower mean MDA level (4.46 $\mu\text{mol/L}$) as compared to those on oral hypoglycaemics (NIDDM) (4.8 $\mu\text{mol/L}$) indicating lesser level of oxidative stress in diabetics on insulin. Considering MDA levels among cases on the basis of their glycaemic status, significant correlation is seen between well controlled and poorly controlled diabetics (both in IDDM and NIDDM). MDA is higher in individuals with poor glycaemic control compared to good glycaemic control. For every 1% reduction in HbA1C, one can expect 35% reduction in microvascular complications, which can be attributed to decrease in oxidative stress on treatment.¹³ The metabolic parameters such as total cholesterol, triglycerides, LDL and VLDL values were more in diabetic groups than the control groups. Mean value of serum HDL is decreased in diabetic group compared to control. Most common lipid disorder observed in DM is the presence of high plasma triglyceride and low HDL cholesterol.¹⁴ Insulin is the principal antilipolytic regulator, acting on hormone sensitive lipase. Without its action as in DM, lipolysis in adipose tissue is increased. As a result, there is increased availability of NEFAS for re-esterification in the liver to produce more triglycerides. Lipoprotein lipase activity is less in insulin deficiency resulting in diminished triglyceride clearance, impaired lipolysis of VLDL and reduced formation of HDL particles.¹⁵ Insulin increases the number of LDL receptor. In insulin deficiency, the level of LDL receptors is low, which causes the increase in LDL cholesterol. LDL oxidation plays an important role in atherogenesis.¹⁶⁻²¹ The uptake of LDL by macrophage (to form foam cell) is increased by oxidation of LDL, Derivatization of ApoB by glycosylation and reaction with malondialdehyde.

CONCLUSION

Oxidative stress is observed more in diabetes mellitus patients. Lipid peroxidation is the marker for oxidative stress, and it is statistically significant in this study. Compared to NIDDM, IDDM patients with good glycemic control have low level of serum malondialdehyde.

Lipid profile is increased in poor glycemic controlled patients (both IDDM and NIDDM patients) and it is reflected in high serum malondialdehyde levels. It is found to be statistically significant in this study group. Strict glycemic control is needed for reducing oxidative stress in diabetes mellitus patients and to prevent its complications.

Further scope of this study is extending its size and follow up for assessing Diabetes mellitus complications in various sub groups. Also, the effect of starting either moderate or high-intensity statins based on the patient's risk profile should be studied intensively.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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