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Study of malondialdehyde and estimation of blood glucose levels in patients with diabetes mellitus with cataract

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Abstract

Increased oxidative stress may contribute to development of complications in diabetes may result from over production of precursors to reactive oxygen radicals and/ or decreased efficiency of inhibitory scavenger systems. Senile diabetic cataract is one of the chronic complications of diabetes mellitus. The present study has been carried out in patients suffering with NIDDM (Type-2) with or without associated cataract. Hyperglycemia causes oxidative stress, as measured by malondialdehyde (MDA) (a lipid peroxidation product) is more in diabetic patients (370.80 n.mol/l) compared to the normal individuals (181.04 n.mol/l) whereas the oxidative stress in diabetics with cataract is significantly more (399.12 n.mol/l) than that in diabetics without complications. Attempts have been made under present study to estimate serum MDA levels as a marker of free radical stress against free radical injury.

Keywords: Diabetes mellitus, Cataract, Malondialdehyde

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Introduction

Cataract appear earlier in life and seem to progress more rapidly in diabetics than in non-diabetic persons (Brownlee 1981, Albert, 1982). Major emphasis has been placed on the polyol pathway wherein glucose is reduced to sorbitol by the enzyme aldose reductase.

Diabetes mellitus can result in frequent periods of hyperglycemia allowing formation and accumulation of sorbitol. Sorbital which appears to function as a tissue toxin has been implicated in the pathogenesis of retinopathy, neuropathy, cataracts, nephropathy and aortic disease (Brownlee 1981, Albert 1982).

Diabetes is associated with two types of cataracts.

1. Senile cataract
2. True diabetic cataract:-It is also called "snow flake cataract or "snow -storm cataract".

It is a rare condition, usually occurring in young adults due to osmotic over-hydration of the lens. (Comprehensive Ophthalmology, 4th edn, pg. no.185). The term "sugar cataract" refers to the cataracts associated with galactosemia and juvenile diabetes mellitus. It also include diabetic cataract in adult diabetes.

Lipid peroxidation is a chain reaction providing a continuous supply of free radicals that initiate further peroxidation, malonaldehyde is a stable end product of lipid peroxidation. The reaction is initiated by an existing free radical ($x^{\cdot}$), by light, or by metal ions.

Malondialdehyde is only formed by fatty acids with three or more double bonds and is used as a measure of lipid peroxidation together with ethane from the terminal two carbons of ω^3 fatty acids and pentane from the terminal five carbons of ω^6 fatty acids.

Oxygen radicals are capable of damaging compounds of all biological molecules such as

1. Nucleic acids.
2. Proteins and free amino acids.
3. Lipids and lipoproteins.
4. Carbohydrates and
5. Connective tissue and macromolecules.

An increase production of Malondialdehyde (MDA) a marker of lipid peroxidation has been found in RBC membranes of diabetic patients (Nagasaki Y, Fufiis, Kaneko T, 1989). The circulating levels of MDA are higher in the plasma of diabetic subjects as compared with those in non-diabetic individuals (Nishigaki L, 1981; Altomare E, 1992). Lipid hydroperoxides decompose to many products including aldehydes such as Malondialdehyde, which can reflect the degree of oxidative stress. Oxidatively damaged lipids have been linked to cause coronary artery disease and degenerative disease of aging.

Materials and Method

The diabetic patients were divided into two groups; the diabetic with complication as cataract and diabetics without complications. The oxidative stress as measured by MDA (A lipid peroxidation product) seen in 75 individuals. The analysis of serum MDA levels in these patients has compared with healthy volunteers. The study has been done in the outpatient clinics of department of ophthalmology and internal medicine at Owaisi hospital and research center and Princess Esra hospital, Hyderabad. The following are the criteria for the selection of Test and Control groups.

The diabetic subjects of age 40 to 70 of both sex and having complication diabetic cataract are included.

The blood samples for the estimation of serum Malondialdehyde and Blood glucose was drawn in a fasting state.

Estimation of blood glucose: By Harold Varley method (Asatoor et al., 1954).

Estimation of malondialdehyde in serum: Thiobarbituric acid reactive substance assay [TBRAS] method.

Statistical analysis: Statistical analysis was done by means of one way analysis of variance. The individual pair wise differences were seen by means of Duncan's multiple range test; the level of significance was set at P=0.05.

Results

Table 1: Descriptive of age of normal, diabetic without cataract and diabetic with cataract subjects by sex

Sex	Group	No. of Subjects	Age				
			Mean	Std. Deviation	Std. Error of Mean	Minimum Age	Maximum Age
Male	Normal	10	48.00	6.912	2.186	38	58
	Diabetic without Cataract	9	53.78	7.629	2.543	42	65
	Diabetic with Cataract	14	61.93	3.912	1.045	54	68
Female	Normal	15	45.80	5.894	1.522	36	56
	Diabetic without Cataract	16	49.50	6.314	1.579	42	64
	Diabetic with Cataract	11	58.73	5.623	1.695	50	70
Total	Normal	25	46.68	6.276	1.255	36	58
	Diabetic without Cataract	25	51.04	6.979	1.396	42	65
	Diabetic with Cataract	25	60.52	4.908	0.982	50	70

Table 2: Descriptive of fasting blood sugar (mg/dl) and malondialdehyde (n.mol/l) of normal, diabetic without cataract and with cataract subject by sex

Parameter	Sex	Group	No	Mean	SD	Sem	Min	Max
FBS(mg/dl)	Male	Normal	10	85.70	3.945	1.248	80	90
		Diabetic without Cataract	9	145.22	10.072	3.357	129	156
		Diabetic with Cataract	14	162.07	7.437	1.988	150	172
	Female	Normal	15	86.40	3.542	0.914	80	90
		Diabetic without Cataract	16	147.63	7.839	1.960	135	160
		Diabetic with Cataract	11	160.91	5.647	1.703	152	171
	Total	Normal	25	86.12	3.644	0.729	80	90

		Diabetic without Cataract	25	146.76	8.579	1.716	129	160
		Diabetic with Cataract	25	161.56	6.602	1.320	150	172
MDA (n.mol/l)	Male	Normal	10	183.50	19.208	6.074	147	213
		Diabetic without Cataract	9	388.33	65.276	21.759	293	480
		Diabetic with Cataract	14	427.50	77.217	20.637	267	540
	Female	Normal	15	179.40	24.377	6.294	149	214
		Diabetic without Cataract	16	360.94	90.485	22.621	196	507
		Diabetic with Cataract	11	363.00	97.149	29.292	213	533
	Total	Normal	25	181.04	22.118	4.424	147	214
		Diabetic without Cataract	25	370.80	81.961	16.392	196	507
		Diabetic with Cataract	25	399.12	90.719	18.144	213	540

Table 3: ANOVA

		Sum of Squares	df	Mean Square	F	Sig
FBS (mg/dl)	Between groups	79895.360	2	39947.680	918.525	0.001
	Within groups	3131.360	72	43.491		
	Total	83026.720	74			
MDA (n.mol/l)	Between Groups	703081.39	2	351540.693	68.319	0.001
	Within groups	370483.60	72	5145.606		
	Total	1073565.0	74			

Table 4: Duncan's multiple range test for FBS (mg/dl)

Group	Mean± SD
Normal	86.12 ± 3.644[a]
Diabetic without cataract	146.76±8.579[b]
Diabetic with cataract	161.56± 6.602[c]

NB: Different superscripts are significantly different (p< 0.05)

Table 5: Duncan's multiple range test for MDA (n.mol/l)

Group	Mean± SD
Normal	181.04 ± 22.118[a]
Diabetic without cataract	370.80 ± 81.961[b]
Diabetic with cataract	399.12 ± 90.719[b]

NB: Different superscripts are significantly different (P < 0.05).

Analysis of fasting Blood Sugar (mg/dl) and Serum MDA (n.mol/l) levels are seen in 75 individuals. Out of them 25 are normal subjects and 50 are diabetic subjects; out of which 25 diabetics without cataract and 25 with diabetic cataract. The data is analyzed statistically and the results are tested by means of one way analysis of variance technique. The descriptive for fasting blood sugar and MDA levels for 25 normal subjects (out of which 10 are male and 15 female subjects) were shown in Table 2. The fasting blood sugar ranges between 80 to 90 mg/dl. The mean and SD for fasting blood sugar (mg/dl) is 86.12± 3.644 and for serum MDA (nmol/l) is 181.04 ± 22.118 respectively. Serum MDA levels are in normal range, ranging from 147-214 nmol/l in males and females. Table 2 gives the descriptive for fasting blood sugar (mg/dl) and MDA for the three categories of both

sex. The fasting blood sugar (mg/dl) of 25 diabetic subjects without cataract (Table 2) ranged from 129-160 mg/dl. The mean and SD for FBS (mg/dl) is 146.76 ± 8.579.

The serum MDA (n.mol/l) levels for the same group are varying from 196-507. The mean and SD for serum MDA (n.mol) is 370.80 ± 81.961. The values are above the normal range in the fasting Blood sugar (mg/dl) of 25 diabetic patients with cataract (Table 2) range from 150-172. The mean and SD for FBS is 161.56 ± 6.602. The Serum MDA (n.mol/l) levels for this group are ranging from 213-540. And the mean and SD for MDA (n.mol/l) is 399.12± 90.719.

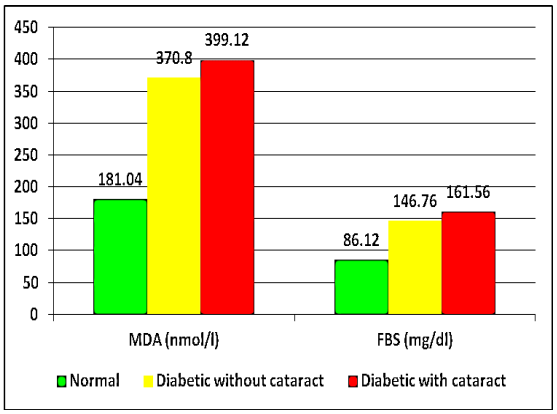

Fig. 1: Shows that there is a significantly high level of MDA in diabetics compared to normal subjects. There is not much difference in MDA levels between diabetics without complications and diabetics with cataract subjects

Discussion

The TBARS (Thiobarbituric acid reactive substances) method is used to estimate malondialdehyde, which is a marker of lipid peroxidation. We have found that the levels of serum MDA were significantly elevated in patients with diabetes compared to those in normal subjects which supports the findings by others (Peuchant E, 1997; Akkus I, 1996; Losada, 1996; Santini SA, 1996; Griesmacher A, 1995; Armstrong D, 1992; Nishigakil, 1981). We have seen that diabetes have increased oxidative stress and hence showed high levels of Serum MDA compared to matched non-diabetics. The average serum MDA levels in Normal subjects is 181.04 n.mol/l, in diabetics without complication it is 370.80 n mol/l and patients with diabetic cataract it is 399.12 n mol/ l. The data analysis revealed a significantly elevated serum MDA levels in diabetic cataract patients ($P < 0.05$) and diabetics without complications ($P < 0.05$) compared to normal individuals. It has been reported that hyperglycemia increases lipid peroxidation and leads to decrease in antioxidants (Auge N, 1995; Ferrari R, 1991).

In studies focusing on a limited number of individuals, antioxidants may not reflect the real antioxidants status of patients. In general antioxidants enzymes such as SOD, CAT, GP_X have been reported to be increased, decreased or unaltered in various tissues of diabetics with wide variation from one tissue to another. These discrepancies may depend on variation in enzyme activity over a time. Compensatory increase in enzyme activity to faced raised oxidative stress, as well as the type of tissue under examination. (Uzel N, 1987; Wolff SP, 1993; Yeh HC, 1987).

The combination of antioxidants will improve the antioxidant status and help in prevention and postponing the onset of diabetic complications such as cataract.

Senile diabetic cataract is one of the chronic complications of diabetes mellitus. Sorbitol is normally present in lens of eyes. But in diabetes mellitus, when glucose level is high, the sorbitol concentration also increases in the lens. This leads to osmotic damage of the tissue and development of cataract. The elevated level of sorbitol has been implicated in the development of neuropathy, cataract and retinopathy in diabetes mellitus.

The early development of cataract of lens is due to the increased rate of sorbitol formation caused by the hyperglycemia.

Conclusion

The oxidative stress as measured by Serum MDA (a lipid peroxidation product) is significant in diabetic patients compared to the normal individuals, where as the oxidative stress in diabetes with cataract is significantly more than that in diabetes without complications. Lipid peroxidation may also play a role in cataractogenesis. The Estimation of serum MDA is significant in diabetic patients with & without cataract compared to normal subjects according to the study done.

References

1. Akkus I, Kalak S, Vural H, Caglayan O, Menekse E, Can G, Durmus G. Leucocyte lipid peroxidation, superoxide dismutase peroxidase and serum and leucocyte vitamin c level with type II diabetes mellitus. Clin Chim Acta. 1996 Jan 31; 244(2):221-7. PMID: 8714439.
2. Albert. The biochemistry of complications of DM. In: H. Keen, J. Jarethi Eds. Complications of diabetes. 2nd edn. London: Edward Arnold Ltd. 1982; pp 231-71.
3. Altomare E, Vendamiale G, Chicco D, Procacci V, Cirelli F. Increased Lipid peroxidation in Type-2 poorly controlled Diabetic patients. Diabetic Metab. 1992; 18:264-271.
4. Armstrong D, Rauk A, Yud. Aminoalkyl and Alkylaminium free radicals and related species; structures, thermodynamic properties, reduction potentials and aqueous energies. J Am Chem Soc. 1992; 115:666-73.
5. Asatoor AM, King EJ. Simplified colorimetric blood sugar method. Biochem J. 1954 Jan 16; XIIV:56. PMID: 13159933.
6. Auge N, 1995.
7. Brownlee. The Biochemistry of the complications of D. M. Ann Rev Biochem. 1981; 50:385.
8. Comprehensive Ophthalmology-Diseases of the lens- 4th edn. pg. 185.
9. Ferrari R, 1991.

10. Griesmacher A, Hauser MK, Andert SE, Schreiner W, Toma C, Knoebl P, Pietschmann P, Prager R, Schnack C, Schemthaner G, Mueller MM. Enhanced Serum levels of Thiobarbituric acid reactive substances in diabetes mellitus. The American journal of Medicine. 1995.
11. Losada, 1996.
12. Nagasaki Y, Fufii S, Kaneko T. Effects of high Glucose and Sorbitol Pathway on Lipid peroxidation of Erythrocytes. Horm Metab Res. 1989;19:89-90.
13. Nishigakil, 1981.
14. Peuchant E, Poor glycemic control. Diabetes, oxidative stress and physical exercise. 1997.
15. Santini SA, Early increase of oxidative stress 1996.
16. Uzel N, Sivas A, Uysal M, Oz H. Erythrocyte lipid peroxidation and glutathione peroxidase activities in patients with diabetes mellitus. Horm Metab Res.1987 Feb; 19 (2):89-90. PMID: 3557287.
17. Wolff SP. Diabetes mellitus and free radicals. Free radicles, transition metals and oxidative stress in the aetiology of diabetes mellitus and complications. British Medical Bulletin 1993 July; 49(3):642-52. PMID: 8221029.
18. Yeh HC, 1987.