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A correlation biomarker between BMI and lipid peroxidation in type 2 diabetes mellitus with and without other complications

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ABSTRACT

Objectives: Body mass index (BMI) is a traditional measurement practice that divides a person's weight by their height to find out whether they have a healthy range of weight. The objective of this study is to understand the relation between BMI and prevalence of diabetes mellitus, hypertension, and dyslipidemia.

Material and Methods: BMI distribution among these patients was compared with and without hypertension and dyslipidemia. The improper of secretion of insulin leads to changes in metabolism of lipids, proteins, and carbohydrates also characterized hyperglycemia generally considered as diabetes mellitus (DM).

Results: The excessive formation of free radicals induces oxidative stress, and the antioxidant defense system becomes weaken and hence arises diabetic disorder and overproduction of malondialdehyde (MDA). In cells, the polyunsaturated fatty acid peroxidation is considered as the final product and marker of oxidative stress.

Conclusion: In this study, significantly increased BMI is observed in diabetic victims in comparison with control group. A significant positive correlation was noticed between glycated hemoglobin, cholesterol, and MDA. In conclusion, for the prevention and management of vascular complication in type 2 diabetes mellitus, maintaining normal levels of MDA and body weight are very important. Further large-scale studies are required to confirm it.

Keywords: Body mass index, Malondialdehyde, Type 2 diabetes mellitus, Lipid peroxidation, Oxidative stress, Free radicals

INTRODUCTION

It is known that the diabetes mellitus (DM) is a metabolic disorder whose prevalence is rising rapidly in an alarming rate worldwide.[1] The DM patients have shown a change in their condition over the past 30 years that a mild disorder of the elderly and now in youth and middle aged become a major cause for morbidity and mortality.[2] Type I diabetes is characterized by hyperglycemia and imbalanced secretion and function of endogenous insulin.[3] The so-called global issue, type II diabetes is develops initially very slowly with insulin resistance and progressing with time which results in failure of the body to maintain glucose hemostasis.[4]

The immune system works in an organized manner for the sustenance of the normal equilibrium, thus helping in achieving a disease-free state. In certain conditions, there is increased free radicals formation resulting in oxidative stress and lipid peroxidation.[5] The complication in diabetic such as diabetic ketoacidosis, nephropathy, neuropathy, and micro- and macro-vascular complications is seen when the reactive oxygen species (ROS) formation is increased.[6]

Lipid peroxidation is leads to pathogenesis of many degenerative diseases such as atherosclerosis, diabetes, and carcinogenesis.[7] Lipid peroxidation initiates fatty acyl side chain or fatty acid of any chemical species with leads to H-atom from a methylene carbon in the side chain, in which removal of the hydrogen atom is much easier which is polyunsaturated fatty acids that are more susceptible to peroxidation.[8,9]

This study intends to analyze the oxidative stress by measuring malondialdehyde (MDA) and BODY mass index (BMI) along with other parameters in type II diabetic patients with and without complications. To correlate the levels of BMI, MDA both diabetic individuals and to find if serum levels of MDA and BMI can be predicted from the values of the same in both the groups.

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MATERIAL AND METHODS

An age group of 40–55 years of both sexes, a study was comprised 70 patients of type 2 diabetic on oral hypoglycemic drugs, attending as outpatient at Andhra Medical College, Visakhapatnam, Andhra Pradesh, was selected for our study. The disordered diabetic patients were classified into two groups according to the presence or absence of other diseases such as hypertension, thyroid disorders, and vascular complications where Group I patients without history of other diseases and Group II patients with other diseases and vascular complications. Group- and sex-matched 30 healthy individuals were selected as a control. The Institution Ethical Committee approval was taken before the study. Experiments were done in accordance with Helsinki Declaration of 1975.

Biochemical analysis

Random fasting blood samples were collected soon after enrolment for the study. The samples were centrifuged for a time interval of 10 min at 2000 rpm. Further, fasting blood glucose and other related lipid profile factors such as total cholesterol and triglycerides were analyzed using auto analyzer. Using ion exchange resin method and thiobarbituric acid reactive substances method, both Glycated hemoglobin (HbA1c) and serum MDA were estimated, respectively.[10]

Statistical analysis

Using SPSS 20.0 software, statistical analyses were done. The statistical significant values were considered by mean ± standard deviation, $P < 0.05$. Using one-way analysis of variance, the general distributed data were analyzed. To conduct correlation analysis, the Pearson correlation test was used.

RESULTS

Table 1 shows the baseline characteristics in the three groups – control (30), type 2 DM without complications (35) and those with complications (35). They are comparable for age, gender, BMI and waist to hip ratio. Table 2 compares the biochemical parameters in the same three groups. All the six parameters are lowest in the control group, and higher in patients of type 2 DM with complications as compared to those without complications. Table 3 gives the coefficient of correlation between biochemical parameters in patients with type 2 DM. All of them are significant at 0.05 level and three (HbA1c, Cholesterol and MDA) are significant at 0.01 level of statistical correlation.

DISCUSSION

The vascular complications and other multifactorial factors confirm the high incidence of type 2 DM.[11,12] In the present study, the lipid profile parameters, FPG, PPG, HbA1c, and also the waist-hip ratio along with BMI show a significant

Table 1: The comparison of baseline characteristics between controls and type 2 DM groups.

	Control group *n*=30	Group I type 2 DM patients without complications (*n*=35)	Group II type 2 DM patients with other complications (*n*=35)
Age	45.7±3.8	46.2±4.5	46.4±4.1
Males (%)	80	81	83
Females (%)	20	19	17
BMI (kg/m^2)	24.8±1.603	27.13±1.586$^{a\#}$	28.53±2.928^{a*}
Waist and hip ratio	0.895±0.037	0.92±0.029$^{a\#}$	0.925±0.025$^{a\#}$

^{a}Controls versus Group I type 2 DM, Group II type 2 DM, ^{b}Group I type 2 DM versus Group II type 2 DM, $*P<0.001$, $\#P<0.05$, and $P<0.05$ are statistically significant, DM: Diabetes mellitus

Table 2: The comparison of biochemical parameters between control and type 2 DM groups.

	Control group *n*=30	Group I type 2 DM patients without complications (*n*=35)	Group II type 2 DM patients with other complications (*n*=35)
FBG (mg/dl)	91.74±8.39	131.7±22.96^{a*}	143.3±42.47$^{a*,b\#}$
PPBG (mg/dl)	107.32±8.185	163.5±21.06^{a*}	193.9±18.44^{a*,b*}
HbA1c	5.9±0.3	7.5±0.51^{a*}	8.613±0.8^{a*,b*}
Cholesterol (mg/dl)	112.3±8.294	191.2±22.33^{a*}	210.3±18.14$^{a*,b\#}$
TG (mg/dl)	99.78±11.89	171.6±17.05^{a*}	183.6±21.1^{a*,b*}
MDA (nmole/dl)	59.48±3.776	93.3±10.09^{a*}	115.5±12.81^{a*,b*}

^{a}Controls versus Group I type 2 DM, Group II type 2 DM, ^{b}Group I type 2 DM versus Group II type 2 DM, $*P<0.001$, $\#P<0.05$, and $P<0.05$ are statistically significant, DM: Diabetes mellitus

Table 3: The correlation between BMI and measured parameters in type II DM patients.

Parameters	Coefficient (r) of correlation
FBG	0.184*
PPBG	0.256*
HbA1c	0.503**
Cholesterol	0.367**
TG	0256*
MDA	0.389**

**Correlation is significant at 0.01 level (two tailed). *Correlation is significant at 0.05 level (two tailed), DM: Diabetes mellitus

increase in type 2 diabetic patients in comparison with healthy volunteers. The above-noticed factors are more in Group II subject when compared Group I. It was noticed that a significant BMI was more in diabetic patients when compared to the control group. It was also noticed that the above increased BMI is correlate with HBA1c, cholesterol, and MDA.

The insulin resistance in type 2 diabetic cases is raised by the increase of both visceral adiposity and obesity. The obesity is resulting in excess adipose tissue, reduces the glucose usage, and increases chronically the circulation of fatty acids.[13] Added to the above, the lifestyle, working atmosphere, environmental factors, and other inheritor factors generate excess adipose tissues. The studies revealed that the reduction of usage of glucose when adiposity exceeds and, hence, increases of fatty acids in circulation takes place.[14,15]

In the present study, it was noticed that the MDA levels increased significantly in Group II diabetic group when compared Group I subjects. Furthermore, the MDA level was more in diabetic patients compared with healthy individuals. It is reported that, through Amadori rearrangement, the production of free radicals increased in hyperglycemic diabetic patients; hence, chances of other diabetic complications such as diabetic retinopathy, cardiopathy, and others increase.[16] Antioxidants present in the body eliminate ROS, thereby reducing cellular damage.[17] It is reported in the pathogenesis of diabetes increases with the increase of oxidative stress.[18,19] The release of ROS takes place by factors such as Fenton reactants, advanced glycation, mitochondrial respiratory chain deficiencies, glucose oxidation, and number of enzymatic and non-enzymatic sources[20] The increased rate of lipid peroxidation and decreased cellular antioxidant mechanisms develop a pathogenic link between hyperglycemia and development of complications in type 2 DM patients.[21]

CONCLUSION

This study shows a positive correlation between BMI and MDA. It concludes, monitoring of MDA levels and reduction of body weight will be helpful for postponement of vascular complications in type 2 DM. Further studies are needed to conduct in a large number of cases, to confirm it.

Declaration of patient consent

Patients' consent not required as patients' identity is not disclosed or compromised.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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