

Research article

Use of malondialdehyde (MDA) as a screening tool for vestibulopathy in Type 2 diabetes mellitusK. Sumathi¹, Gayathri Dilliraj², Sridevi Chaganti³, Shenbaga Lalitha³¹Associate Professor, ²Tutor, ³Assistant Professor, Department of Biochemistry, Sree Balaji Medical College & Hospital, Chrompet, Chennai 44. Tamil Nadu, India

(Received: March 2021 Revised: August 2021 Accepted: September 2021)

Corresponding author: **Gayathri Dilliraj**. Email: dr.gayathridilliraj@gmail.com**ABSTRACT**

Introduction and Aim: Diabetes mellitus, especially type II DM is one among the most prevalent metabolic diseases in the global scale. One of the commonest complications of diabetes mellitus is vestibulopathy affecting the inner ear. Malondialdehyde (MDA) obtained from lipid peroxidation of poly unsaturated fatty acids (PUFA) is an important compound that generally serves as one of the key markers for oxidative stress. The aim of the study is to prove the significance of MDA in Vestibulopathy in Type-2 i.e., non-insulin dependent diabetes mellitus.

Methodology: A cross-sectional study of 100 diabetic patients of age group between 35 years and 50 years were tested for vestibular function by electronystagmography (Commonly used test to determine and evaluate vestibular system). Based on the biothermal caloric stimulation the Clausen butterfly chart was generated and thus the code is ascertained. Serum levels of Malon-di-aldehyde were assayed by TBARS method (Thiobarbituric acid Reactive substances).

Results: The study proved, that there was a 4 times increased risk of developing vestibulopathy with increasing duration of diabetes. It also proved that there was an increased risk of developing vestibulopathy in diabetic patients, having MDA > 2µmol/L.

Conclusion: Thereby the study confirmed the clinical significance of periodic screening of MDA levels, in diabetic patients, particularly those with uncontrolled/poor glycemic control & with longer duration of diabetes. Estimation of their serum MDA levels and vestibular function by the electronystagmography test, is advised in order to prevent the occurrence of diabetic vestibulopathy at the earliest and also to prevent the worsening of any such, other complications associated with the disease.

Keywords: Diabetes mellitus type II; vestibular function tests; malondialdehyde (MDA); diabetic vestibulopathy.

INTRODUCTION

Diabetes mellitus, is one among the leading, commonly prevalent metabolic diseases globally. It is also one of the diseases that can have a familial pattern of inheritance (1). Thus, all the subsets of the population are vulnerable to either inherit/to develop diabetes, owing to their sedentary lifestyle and unhealthy eating patterns of this modern era (2). Though it is said to be a metabolic disorder that is mainly associated with increased blood sugar levels. It has been proved and widely accepted as a multisystem disorder that involves the various systems of the body. One of the commonest complications of diabetes mellitus is vestibulopathy affecting the inner ear (3). This will lead to disturbances in the balance, affecting the day-today activities in the diabetic population. Due to this imbalance the diabetics usually suffer from frequent attacks of giddiness leading to fall causing fractures leading to immobilization (4). Sometimes the patients may even need surgery to correct such complicated fractures. Various global studies have scientifically proved the strong association between sensorineural hearing loss (SNHL) and vestibular dysfunction (VD) in diabetic

patients, especially in Type-II diabetes mellitus (DM; 5).

Among the various known organic compound, Malondialdehyde (MDA) is an important compound that serves as one of the key markers for oxidative stress (6). Lipid peroxidation of polyunsaturated fatty acids, is the principal mechanism involved in synthesizing Malondialdehyde (MDA;7). Various previous studies have been established, regarding the common scientific use of MDA in:

- Alcoholic hepatitis as a prognostic factor (8)
- In various pathological disease, as a biomarker for assessing oxidative stress (9)
- As a biomarker of air pollution induced oxidative stress, in exhaled breath condensate and urine (10) etc.,

The primary aim of this study was to prove the association between malondialdehyde levels and vestibulopathy in type 2 diabetes mellitus.

MATERIALS AND METHODS

It was a cross-sectional study conducted in the premises of Sree Balaji medical college and hospital, Chennai. It was conducted by the Biochemistry

department of the central laboratory, in co-ordination with the ENT department.

Inclusion criteria

The study included 100 diabetic patients of age group between 35-50 years of age, consisting of 50 men and 50 women within the specified age group. All of whom had come to the hospital for their regular annual master checkups.

Exclusion criteria

Persons working in highly noisy-machinery involved environment, past trauma to the ear/head injury, any drug intake of ototoxic drugs like streptomycin etc., any history of significant ear infection in the past, with no known relevant family history of vestibular dysfunction.

All the participants were explained in detail about the significance and the need of this study, and all their written consents were obtained, thereby asserting their acceptance to be a part of the study. Ethical committee clearance was also obtained from the administration, for conducting this study (Ref no. 01/HEC/2010-37).

Their vestibular function was tested by Electronystagmography test, which is the gold standard test to detect the vestibular functions (11). Based on the biothermal caloric stimulation method, the Clausen butterfly chart was generated and thus the code was ascertained to estimate their vestibular function. Their serum levels of MDA, was assayed by the TBARS method (Thiobarbituric acid Reactive substances;12).

Statistical analysis

MS excel sheet was used to make all the data entry. The software package for social sciences, version SPSS 18 was used to do the statistical analysis.

RESULTS

Figure 1 shows the proportional numbers of persons in successive age categories in our study population:

- 51-55 years – constituted 36%
- 46-50 years - constituted 34%
- 41-45 years - constituted 17%
- 35-40 years - constituted 13%.

The mean age of our study participants was 42±6.3 years.

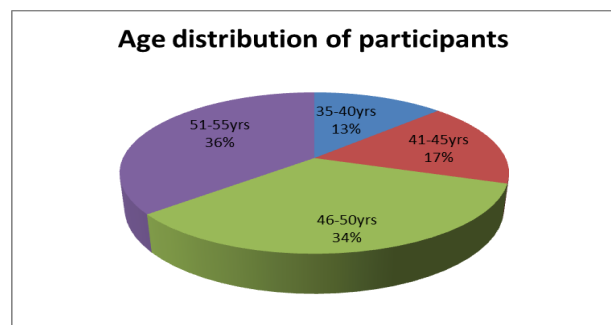


Fig. 1: Age distribution of participants

Figure 2 depicts that about 70 % of the participants, have had diabetes for a period of more than 4yrs and the remaining 30 % of the participants have had diabetes for a period of less than 4yrs.

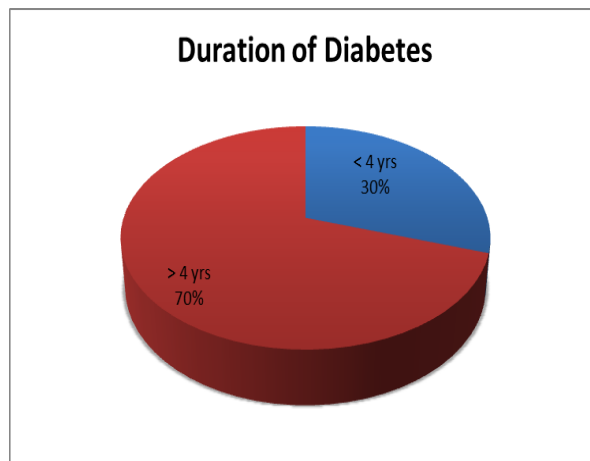


Fig. 2: Duration of diabetes

Table 1: Characteristics of study participants

Parameters	Mean	SD
Age (years)	42	6.3
FPG (mg/dL)	146	12
HbA1c (%)	7.9	0.8
MDA (µmol/L)	3.4	1.7

SD- Standard Deviation; FPG- Fasting Plasma Glucose; HbA1C – Glycated haemoglobin; MDA- Malondialdehyde.

The results obtained showed that:

- Of the 78 diabetic subjects with MDA levels >2 µmol/L, 53 of them had vestibulopathy while the remaining 25 were normal,
- Of the 22 diabetic subjects with MDA levels up to 2 µmol/L, 4 of them had vestibulopathy while the remaining 18 were normal. There was a significant p value of 0.0002 (i.e., p value of .05) which is considered to be statistically significant.

Table 2: Overall comparison of the serum MDA levels and the vestibular functions in all the 100 type II diabetic subjects

MDA levels	Vestibular function test		Total	Odds ratio	P value
	Normal	Abnormal			
<2 µmol/L	18	4	22	9.54	0.0002
>2 µmol/L	25	53	78		

DISCUSSION

Diabetes Mellitus is a multisystem disorder characterized by chronic hyperglycaemia that causes varying degree of pathophysiological complications, affecting the various systems of the human body ranging from cardiovascular defects to renal abnormalities. One of the significant mechanisms

contributing to these findings, is the generation of reactive oxygen species (ROS), induced by chronic hyperglycaemia (13). Diabetes mellitus being an inflammatory disease promotes the generation of reactive oxygen species denoted by the marked increase in lipid oxidation and glycooxidation products seen in the tissue proteins and plasma of the diabetic patients (14) which is highly suggestive of oxidative stress, that is one of the causative factors for diabetic vestibulopathy (15).

MDA is a by-product formed by lipid peroxidation from free radicals and is highly toxic (16). MDA has been scientifically proved for being used as a prognostic factor/biomarker for various pathological disorders like alcoholic hepatitis, air pollution impact on the respiratory system etc., (8-10). The role of MDA in screening diabetic patients for determining their risk of developing cochleopathy that can lead to irreversible sensorineural hearing loss has been illustrated by studies (17). Poorly controlled/uncontrolled/chronic diabetic patients are more susceptible to develop vestibulopathy (18, 19).

In our cross-sectional study consisting of a study population of 100 type II diabetic patients, we tried to evaluate the association between MDA levels and Vestibulopathy (induced by free radicals obtained from lipid peroxidation, seen in chronic diabetics).

36% of the participants were in 51-55 years age group, 34% were in 46-50 years age group, 17% were in 41-45 years age group and 13% were from 35-40 years age group. 70 percent of the study population have had diabetes for more than 4 years, while the remaining 30 percent have had it for a period of less than 4 years. The results of our study showed that, the incidence of developing vestibulopathy was much higher in the diabetic subjects with MDA levels of $>2 \mu\text{mol/L}$ (53%), when compared with the diabetic subjects with MDA levels $<2 \mu\text{mol/L}$ (4%). There was a p value of 0.0002 (i.e. p value of .05) which is considered to be statistically significant.

Thus, the study scientifically ascertained that, there is an increased risk of developing vestibulopathy in diabetic patients having comparatively higher MDA levels. It also showed that there was a 4 times increased risk, of developing vestibulopathy with increasing duration of diabetes. So, this study correlates the levels of MDA with oxidative stress in diabetic vestibulopathy. It is also advisable for the diabetics to have their glycemic status under good control and to combat the oxidative stress by intake of antioxidants thereby preventing the occurrence of such morbid complication (20).

CONCLUSION

Among the various known micro vascular and macro vascular complications associated with diabetes mellitus, auditory complications are mostly neglected or remains unchecked until disabling dizziness, or

trouble with balance occurs in most cases. The results obtained from our study ascertained, that the vestibular impairment in diabetic patients is influenced mainly by the oxidative stress. And it was concluded that the incidence of vestibulopathy is higher in those diabetic with MDA levels $>2 \mu\text{mol/L}$.

Thus, our study yet again emphasizes the need for regular screening of diabetic patients particularly those with poor glycemic control and with longer duration of diabetes, by estimating their serum MDA levels and vestibular function by electronystagmography test periodically. In order to prevent the occurrence of diabetic vestibulopathy at the earliest and also to prevent the further worsening of the complications. So it is advisable for all the diabetic patients to get these relevant investigations tested at least once in every six months, as prevention is always better than cure.

ACKNOWLEDGEMENTS

Thanks to all the subjects for their contribution and active participation in the study. A special thanks to all the co-authors from the department of Biochemistry and ENT, Sree Balaji Medical College and Hospital, for their assistance and expertise throughout all aspects of our study and for their help in writing the manuscript.

CONFLICT OF INTEREST

There is no conflict of interest to be disclosed.

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