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Original Research Article

Correlationship of Membrane Potential, Malondialdehyde and Ascorbic Acid in People Living with Diabetics in Owerri

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Abstract: This study was investigated to evaluate the level of malondialdehyde, ascorbic acid and membrane potential among diabetic patients in Owerri.100 diabetics patients and 100 apparently healthy subjects between the ages of 45-60 years admitted to General Hospital Owerri were selected in this study. Fasting venous blood was collected and was used for the determination of malondialdehyde, ascorbic acid and membrane potential. The results obtained revealed that the levels of malondialdehyde was increased in diabetics when compared with the control. While membrane potentials and ascorbic acid were significantly decreased in diabetics patients when compared with the control at P<0.05. This could probably imply increase of malondialdehyde and decreased membrane potential as well as decreased ascorbic acid could lead to oxidative stress.

Keywords: Malondialdehyde, Membrane Potential, Ascorbic Acid, Diabetics, Patients.

INTRODUCTION

Diabetes mellitus is a disorder in which the body does not produce enough or respond normally to insulin, causing blood sugar (glucose) levels to be abnormally high. Diabetes mellitus is a disorder in which the amount of sugar in the blood is elevated. Diabetes is a disease that occurs when blood glucose is too high. Glucose is the body's main source of energy. The body can make glucose, but glucose also comes from the food eaten [1].

Diabetes raises the risk for damage to the eyes, kidneys, nerves, and heart. Diabetes is also linked to some types of cancer. Taking steps to prevent or manage diabetes may lower the risk of developing diabetes health problems. The most common types of diabetes are type 1, type 2, and gestational diabetes. Malondialdehyde (MDA) is a highly toxic by-product formed in part by lipid oxidation derived free radicals. Many studies have shown that its concentration is affected considerably in diabetes mellitus. Malondialdehyde reacts both irreversibly and reversibly with proteins and phospholipids with profound effects. In particular, the collagen of the cardiovascular system is not only stiffened by cross-links mediated by malondialdehyde but then becomes increasingly resistant to remodelling. It is important in diabetes mellitus because the initial modification of collagen by sugar adducts forms a series of glycation products which then stimulate breakdown of the lipids to malondialdehyde and hence further cross-linking by malondialdehyde of the already modified collagen. Malondialdehyde (MDA) is generated by both lipid oxidation and as a by-product of prostaglandin and thromboxane synthesis [2].

Ascorbic acid is one of the most important micronutrient required for various Physiological roles in the human system. Evidences suggest that vitamin C is affected in diabetes mellitus. Ascorbic acid is an important vitamin that has well established biological role due its antioxidant nature [3]. The human population is unable to produce their own ascorbic acid, and hence, it must be strictly obtained from the dietary sources. Vitamin C rich foods are pretty common and regularly consumed in our daily diet. Inadequacy occurs due to the excessive consumption of vitamin C in destabilizing the free radicals [4].

Additionally, the membrane potential and malondialdehyde may be affected in diabetics [5]. This membrane potential may be due to differences in the concentration and permeability of important ions across a membrane, which could result in an imbalance in the concentrations of ions across a membrane. The membrane potential is simply the difference in voltage (or electrical potential) between the inside and outside of a cell [6]. In fact, human life may be greatly impacted without membrane potentials. It is true that living cells maintain a potential difference across their membrane. Because of the unequal concentrations of ions across a membrane, the membrane has an electrical charge. Variations in membrane potential lead to action potentials and allow cells to transmit messages throughout the body [7].

According to the information above, action potentials are electrical signals that send afferent messages out of the brain to cause a certain reaction and efferent messages to the central nervous system for processing. Membrane potentials are created by a number of active transporters that are incorporated in the cellular membrane, as well as by the lipid bilayer's universal cellular structure. The function of membrane potential is to transmit and receive signals to and from the central nervous system. It is essential to cellular biology and illustrates the primary connections between electrochemistry and physiology in cell biology [8]. This study assessed the levels of ascorbic acid, malondialdehyde, and membrane potential in diabetic patients in order to gather data for improved diagnosis and treatment.

MATERIAL AND METHODS

Research Design

A case control study design was conducted in General Hospital Owerri from February 2022 to November 2022.

Ethical Clearance

Participants gave their informed consent, and the study was carried out in accordance with the hospital's ethical guidelines.

Subjects

A total of 100 confirmed diabetics patients within the ages of 45-60 years attending General Hospital Owerri were involved in the study while 100 apparently healthy non diabetics within the ages of 45-60 years served as control.

Blood Collection

Four milliliters of fasting veinous blood were drawn from each subject and placed in a plain and EDTA bottle. The whole blood was centrifuged at 5,000 g for 10 minutes in a Wester fuge (type 684) centrifuge in order to separate the serum.

Biochemical Assay

The serum malondialdehyde and ascorbic acid were determined by standard method [9]. While membrane potential was determined by calculation using Nerst Equation.

Statistical Analysis

The results were expressed as mean ± standard deviation. The independent students t-test was used to undertake the statistical analysis of the data. A significance level of $p<0.05$ was determined.

RESULTS

Table 1: Malondialdehyde, ascorbic acid and membrane potential in diabetics and healthy control

Parameters	Control	Diabetics
Malondialdehyde (µmol/L)	0.9 ±0.04	3.2 ± 1.6 *
Ascorbic acid (mg/dl)	1.3 ± 0.4	0.5±0.03*
Membrane potential (J)	275± 21.5	110±31.3*

DISCUSSION

In this study the level of Malondialdehyde was significantly increased in diabetics when compared with the control. This is in line with the work of [10]. The increase in concentration of Malondialdehyde could be linked to oxidative stress in which high level of free radicals is released. [11]. Oxidative stress is closely associated with a rise in malondialdehyde (MDA) concentration. When the body's capacity to eliminate free radicals, also known as reactive oxygen species (ROS), with antioxidants is out of balance, oxidative stress results. Lipid peroxidation results from free radicals attacking polyunsaturated fatty acids in cell membranes. One significant consequence of this lipid peroxidation process is MDA. Higher oxidative stress is seen in tissues, plasma, or other bodily fluids with greater MDA levels, which show enhanced lipid oxidative damage. Since MDA can combine with proteins and DNA to generate toxic adducts that impede their function, elevated MDA levels not only indicate continuous lipid damage but also contribute to cellular malfunction.

Studies and clinical evaluations frequently employ these high MDA levels as a biomarker to track diseases linked to oxidative stress, including cancer, neurological diseases, and cardiovascular diseases. Strategies such as increasing antioxidant intake, lowering stressor exposure, and changing lifestyle choices can help counteract oxidative stress by lowering MDA levels and minimizing damage from free radicals [12]. In this study, diabetics' ascorbic acid levels were considerably lower than those of the control group. Because free radicals and reactive oxygen species have a greater effect in diabetes mellitus, there is a greater need for antioxidants to scavenge these free radicals. To make up for these shortcomings, however, individual consumption needs to be raised.

Vitamin C supplements may be helpful for those with diabetes mellitus [13]. In this study, diabetes patients' membrane potential was considerably lower than that of the control group. Depolarization of resting membrane potential and a reduction in action potential (AP) amplitude are two ways that diabetes can impact membrane potential. Diabetes may cause an increase in the amplitude of the total sodium current. A change in the inner mitochondrial membrane potential is observed in populations of sensory neurons in diabetics. The three primary factors that affect membrane potentials in cells are the amount of ions present both within and outside the cell, the permeability of the cell membrane to those ions via specific ion channels, and the activity of electrogenic pumps [14].

The charge shift is typically caused by a sodium ion inflow into a cell, but it can also be mediated by any kind of cation inflow or anion efflux. This is consistent with [15]'s research. This suggests that there is less cell activity in diabetics. This may be associated with high levels of cell depolarization and free radical generation, as well as increased utilization of the ATPase enzyme, a solute pump that pumps potassium into cells and sodium out of cells despite their concentration gradients.

CONCLUSION

This reduction of ascorbic acid and cell membrane potential as well as increased malondialdehyde in diabetics could lead to oxidative stress.

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