Alterations in Malondiadehyde and membrane potential in anaemic patients

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Abstract: *Background:* Anaemia is a decrease in the total amount of red blood cells (RBCs) or hemoglobin in the blood and has a lowered ability of the blood to carry oxygen. *Aim and Objectives:* To determine the level of Malondiadehyde and membrane potential in anaemic patients attending General Hospital Owerri. *Materials and methods:* Fifty confirmed anaemicc patients and fifty apparently healthy subjects (control) between the ages of 10 to 20 years were selected in this study. Serum malondialdehyde (MDA) and membrane potential were estimated using standard methods. *Results*: There serum levels of MDA was significantly increased in anaemic patients when compared to control (p<0.05). While the membrane potential was significantly decreased in anaemic patients when compared with the control (P< 0.05). *Conclusion:* These could probably imply that anaemic patients could be prone to oxidative stress as well as have low cell activity.
Keywords: Malondiadehyde, Membrane Potential, Anaemia, Owerri

Introduction

Malondialdehyde (MDA) is one of the final products of polyunsaturated fatty acids peroxidation in the cells. A rise in free radicals causes overproduction of MDA [1]. It is commonly known as a marker of oxidative stress. Malondialdehyde results from lipid peroxidation of polyunsaturated fatty acids. Malondialdehyde is one of the most frequently used biomarkers providing an indication of the overall lipid peroxidation level [2].

Reactive oxygen species degrade polyunsaturated lipids, forming malondialdehyde. In fact, this type of compound is a reactive aldehyde. It is one of the many reactive electrophile species that results in toxic stress in cells and form covalent protein adducts [3]. The production of this aldehyde is beneficial as a biomarker to measure the level of oxidative stress in an organism. Malondialdehyde reacts with deoxyadenosine and deoxyguanosine in DNA, forming DNA adducts, the primary one being M1G, which is mutagenic [4]. The guanidine group of arginine residues condense with malondialdehyde to give 2-aminopyrimidines. However, human ALDH1A1 aldehyde dehydrogenase is capable of oxidizing malondialdehyde. It is reactive and potentially mutagenic [5-6]. One of the prominent risk factors for increased lipid peroxidation is anaemia. Anaemia is a decrease in the total amount of red blood cells (RBCs) or hemoglobin in the blood. It has a lowered ability of the blood to carry oxygen [7]. Common symptoms are due to the reduced amount of oxygen in the body. These include tiredness, having little energy (lethargy), feeling faint and becoming easily breathless. The level of anemia must be significant before a person becomes noticeably pale [8].

Other symptoms may occur depending on the underlying cause. Three main types of anemia are due to blood loss, decreased red blood cell production, and increased red blood cell breakdown. Blood loss could be through trauma and gastrointestinal bleeding [9]. The cause of decreased production include iron deficiency, a lack of vitamin B12, thalassemia, and a number of neoplasms of the bone marrow. While the causes of increased breakdown include a number of genetic conditions such as sickle cell anemia, infections like malaria, and certain autoimmune diseases. It can also be grouped based on the size of red blood cells and amount of hemoglobin in each cell. If the cells

are small, it is microcytic anemia. If they are large, it is macrocytic anemia while if they are normal sized, it is normocytic anemia. It is a public health problem affecting about a third of the global population. Anaemia is more common in women than men particularly during pregnancy, and in children and the elderly [10]. In Owerri Imo State Nigeria, there is scarcity of data on Malondiadehyde and membrane potential in anaemic patients patients. This study was embarked upon to evaluate status of Malondiadehyde and membrane potential in anaemic patients.

Material and Methods

Subjects: Fifty anaemic patients (25 males and 25 females) aged 10 to 20 years attending General Hospital Owerri were involved in this study. Also, fifty apparently healthy subjects aged 10 to 20 years were used as control. Their consent was obtained as well as ethical approval from the ethical committee of the hospital. The extracellular cation concentrations were determined from serum samples while intracellular concentrations were determined from lysed erythrocytes.

Blood Collection: In all subjects 4ml of fasting veinous blood was collected into plain and EDTA bottle. The serum was separated by centrifuging the whole blood in westerfuge (model 684) centrifuge at 5,000g for 10 minutes.

Biochemical Assay: The serum malondiadehyde was determined based on the reaction of MDA with thiobarbituric acid (TBA) [6]. While membrane potential was determined by calculation using Nerst Equation.

Statistical Analysis: The values were expressed as mean ± standard deviation. The student t-test was used to calculate the significant differences at $P<0.05$.

Results

Table-1: Malondiadehyde and Membrane potential in anaemia patients and healthy control		
Parameters	**Anaemia**	**Control**
MDA (umol/l)	0.74 ± 0.31 *	0.21 ± 0.03
Membrane potential (J)	231.77±41.00	94.82±62*
*Significantly different from control at P<0.05		

Discussion

Oxidative stress is a common mediator in pathogenicity of anaemic risk factors. Oxidative modifications of cellular proteins, whether reversible or irreversible, are a causal step in cellular dysfunction. Identifying markers of oxidative stress has been the focus of many researchers as they have the potential to act as an integrator of a multitude of processes that drive anaemia [8].

It was observed that the level of malondialdehyde was significantly increased among the anaemic patients when compared with the control. This is in line with the work of [11]. The increase in MDA could be linked to oxidative stress in anaemia. Oxidative stress is as a result of excessive production of highly reactive oxygen species or their insufficient removal leading to increased free radical production [12]. Though reactive oxygen species may be involved in various cellular mechanisms, ROS may have a positive impact on the body, when they are not in excess. In addition, the high MDA level could result in disturbance of the enzymatic activity, which contributes to higher oxidative stress in anaemia [13-14].

In this study, the membrane potential was significantly decreased in anaemic patients when compared with the control. The change in charge could occur as a result of influx of sodium ions into a cell, although it can be mediated by either an influx of any kind of cation or efflux of any kind of anion. This is in line with the work of [15-16]. This means that there is reduction in cell activity in anaemic patients. This could be linked to decreased hemoglobin.

Conclusion

In conclusion, anaemic patients could be prone to oxidative stress as a result of increased MDA as well as weak cell activity due to decreased membrane potential.

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