Original Article

DOI: 10.7860/NJLM/2017/24075:2209

Biochemistry Section

A Comparative Assessment of Serum Malondialdehyde Level and Paraoxonase Activity in Healthy and Kwashiorkor Children

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ABSTRACT

Introduction: Malnutrition is associated with increased oxidative stress. Increased oxidative stress can change the cellular function in many diseases including protein energy malnutrition.

Aim: To compare serum malondialdehyde level and paraoxonase activity in healthy and kwashiorkor children.

Materials and Methods: This case-control study was done to assess the serum level of Paraoxonase 1 (PON1) and Malondialdehyde (MDA) level in kwashiorkor (as cases) and healthy children (as control). Serum MDA levels and PON1 levels were measured spectrophotometrically.

Results: The level of MDA was significantly increased in kwashiorkor children ($p<0.001$) and PON 1 activity was significantly decreased in kwashiorkor children ($p<0.001$)

Conclusion: The study concluded that increased oxidative stress results in decreased antioxidant system. Hence, children suffering from malnutrition should be given antioxidant supplement so as to reduce the severity of the disease.

Keywords: Antioxidants, Oxidative Stress, Protein-Energy Malnutrition (PEM), Reactive oxygen species

INTRODUCTION

In India Protein-Energy Malnutrition (PEM) is quite common. It is related to a group of related disorders that include marasmus, kwashiorkor and marasmic-kwashiorkor [1]. Kwashiorkor is characterized by hypo-albuminemia and oedema. Oxidative stress occurs a result of imbalance between formation of ROS and antioxidant defense system [2] and may occur in diseases such as malnutrition where there is insufficient micronutrients to meet the needs of antioxidant defenses [3]. Oxidative stress can be significant especially if the individual is exposed to environmental challenges which increase the production of ROS above the normal level e.g., Keshan disease and kwashiorkor. The incidence of kwashiorkor increases following meal of epidemics and may be precipitated in severe malnutrition. This severe malnutrition can be associated with enhanced infection. Further, enhanced infection may also be responsible for increase in oxidative stress in kwashiorkor [4,5].

Lipid peroxides derived from polyunsaturated fatty acid are unstable and form a complex series of compound in which most abundant is MDA. Human have developed a complex antioxidant system to control production and reduce damage from free radicals including PON1. PON1 is a protein with a molecular mass of 43 kda and having 354 amino acids. It provides the protection to the nervous system against the organophosphate neurotoxicity in the circulation [6,7]. PON1 activity has been suggested to be inversely associated with oxidative stress in serum LDL and macrophages [8]. In the present study the aim was to estimate PON1 and MDA in Kwashiorkor children.

MATERIALS AND METHODS

This case-control study was carried out in the Department of Biochemistry, M.G.M College Indore, India, for the period of June-2014 to May-2016. The subjects who admitted in MY Hospital of MGM Medical College Indore or attending the Outpatient Department (OPD) were taken in the study. In the present study, total 425 subjects were selected as per statistician suggestions, availability of cases in stipulated study duration and belonged to western part of Madhya Pradesh. Out of total subjects 250 children suffering from kwashiorkor (age 1-3 years) considered as case group. Besides it, 125 children with apparently normal and healthy were considered as control group (age 1-3 years). The cases and controls were selected in a way that they fulfill the criteria for the matched age, gender, geographical distribution, ethnicity and so forth. The study was approved by M.G.M College ethical committee. The signed consent forms were taken from all children's guardians. The subjects (guardians) who were not willing to participate and did not sign the

informed consent form were excluded from the study. The cases having other chronic diseases besides kwashiorkor were also excluded from the study.

Blood samples were obtained after an overnight fast and serum was separated immediately after centrifugation. Serum samples were stored (-70°C) until analysis. All reagents for test were purchased from Sigma and Merck. Serum MDA levels were measured according to method described by Jain SK et al., and Baskol G et al., [9,10]. The principle of this method is based on spectrophotometry measurement of the color formed during the reaction.

The concentration of TBA reactive substances were calculated by the absorbance coefficient complex were used as standard for evaluation of results [10,11]. The serum PON-1 activity was measured by previously described method [10,11]. Principally, measurement was based on the rate of hydrolysis of paraoxon that was assessed with monitoring the increase in absorbance at 405 nm (25ºC). For this the basal mixture consists of 1.0 Mm PON1 and 1.0 M calcium chloride in 0.05M glycine buffer (pH-10.5).

STATISTICAL ANALYSIS

Data obtained from the study group were compared by student 't'-test. Correlation analysis between variable made by Pearson's test ($p<0.05$) were considered as statistically significant. All the results were expressed as mean with their standard deviation (mean±SD).

RESULTS

All data were presented as (mean±SD). MDA level was significantly elevated in kwashiorkor children as compared to control ($p< 0.001$) which was highly significant [Table/Fig-1] and the PON1 activity was decreased in kwashiorkor children as compared to control ($p<0.001$) which was also highly significant [Table/Fig-1]. There was a perfect negative correlation between MDA and PON1 activity (-0.2071, $p<0.0001$) which was statistically significant [Table/Fig-2].

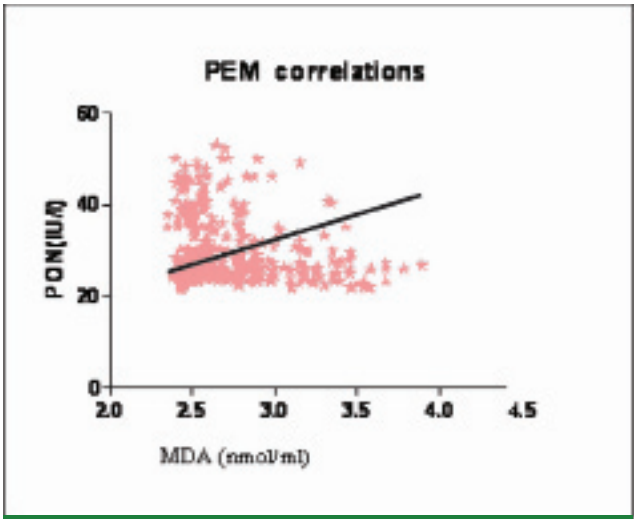
Parameters	Controls	Cases (Kwashiorkor)	p-Value
MDA (nmol/L)	1.05±0.066	3.01±0.323	< 0.001
PON-1 (IU/L)	208.37±11.54	28.61±7.005	< 0.001

[Table/Fig-1]: Representation of level of MDA and PON 1 activity in cases and controls.

DISCUSSION

The study was conducted in western region of Madhya Pradesh, India. These regions have its unique geographical structure and ethnicity. On the ground of significance, present study first time exploring the status of PON1 in Kwashiorkor. Along with PON1, the status of MDA has been also explored in Kwashiorkor children.

In present study, significantly increased status of MDA has been observed in the kwashiorkor children as compared with healthy controls ($p<0.001$)[Table/Fig-1]. Previous literatures provide the information regarding the significant increase in the level of malondialdehyde in the case of increased lipid peroxidation [12]. Lipid peroxidation is assessed by maximal rate of MDA formation and the result agrees with that of Talti MMH who reported increased MDA concentration in the serum of marasmic children as compared to control [13].



[Table/Fig-2]: Representation of correlation between PON 1 and MDA in cases.

PON1 is an enzyme that acts as antioxidative enzyme and connected with high density lipoprotein in human. It has important role in human physiology, such as organophosphates hydrolysis, protects the low density lipoprotein from oxidative modification and has capacity to eliminate the lipid soluble free radicals [14,15]. Thus, PON1 is an important antioxidant. Till now, no such previous study present in literature regarding the PON1 status in kwashiorkor children. According to present study, the mean level of PON1 was significantly reduced in kwashiorkor children as compared to healthy controls ($p<0.001$, [Table/Fig-1]. Same decreased status of PON1 has been also reported by Ece A et al., among the marasmic children [16]. Lower activity of PON1 in kwashiorkor children may be related to decrease hepatic synthesis of this enzyme. This decrease could be related to enhanced lipid peroxidation, since oxidized lipids are reported to inhibit PON1activity. Increase in MDA level causes decrease in PON1 in malnourished children and this may be related to increase in cytokines [17]. PON1 activity may alter the inflammatory response. During the acute phase response HDL may show inflammatory response possibly due to loss of PON1 activity [18].

On correlative status, it is observed that status of PON1 has been significantly and negatively correlated to status of MDA in kwashiorkor children ($p<0.05$), [Table/Fig-2]. Thus indicating the presence of oxidant and antioxidant imbalance in correlative manner.

LIMITATIONS

The study is limited to measurement of PON1 and MDA status only. It is a Hospital based study, hance can not give epidemiological explanation.

CONCLUSION

There is imbalance between oxidant/antioxidant capacities in kwashiorkor children. Increased oxidant (MDA) along with decreased antioxidant (PON1) status has been observed in kwashiorkor children as compared to healthy controls. Thus, oxidative stress has been increased. This increased oxidative stress may be due to the deleterious effects of protein deficient and inadequate intake of micronutrient. Hence, antioxidant supplement should be given so as to reduce the severity of the disease. Further investigations are required for explaining the mechanisms of the oxidant/antioxidant imbalance in kwashiorkor children.

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FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Publishing: **Apr 01, 2017**