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A COMPARATIVE STUDY OF OXIDATIVE STRESS AND ANTIOXIDANTS LEVELS IN PRETERM AND TERM INFANTS AND THEIR MOTHERS

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ABSTRACT

Free radical injury is thought to be one of the common mechanisms for several diseases in preterm infants. Lipid peroxidation plays a vital role in the pathogenesis of many neonatal complications because the antioxidant system of preterm infants is highly stressed and incompletely developed. We aimed to determine the oxidative stress [Malondialdehyde (MDA)] and antioxidants [Total antioxidant activity (TAA) and Vitamin E] in cord blood of preterm (n=20) and term infants (n=20) and in the blood of their mothers. In preterm infants and their mothers TAA and Vitamin E levels were low as compared to term infants and their mothers. In preterm infants and their mothers MDA was high as compared to term infants and their mothers. Therefore it is possible to postulate that preterm infants and their mothers are more susceptible to oxidative stress than term infants and their mothers.

KEY WORDS

Malondialdehyde, Mothers of preterm infants, Mothers of term infants, Preterm infants, Term infants, Total antioxidant activity, Vitamin E.

INTRODUCTION

Pregnancy is confronted with aggressive episodes of progressive and periodic changes in metabolic and physiological profile. Consequently remarkable and dramatic events occur during this period for sustaining mother and fostering the growth and maintenance of fetus. Pregnancy while not a disease often accompanied by a high-energy demand of many bodily functions and an increased oxygen requirement. One of the adaptive changes in the respiratory physiology from 8th week onwards, where minute ventilation initially increased by 36% and ultimately reaches to the maximum of 50% or more to meet the increasing demands of oxygen by mother to meet the requirement of fetus which could rise up to 30-35%. The increased oxidative stress in pregnancy is because of an enhanced aerobic environment [1].

Antioxidant defense mechanisms of the body include cellular and extracellular enzymes and free radical quenchers like Vitamins E, C and A [2]. Cord blood antioxidant activity is the result of overall intrauterine experience. Genetic variability, maternal oxidative stress and maternal antioxidant activity are likely to alter the cord blood antioxidant activity. After birth, increased oxidative stress will result in a decreased antioxidant activity. Once the antioxidant activity is overwhelmed, then an increase in oxidation products of lipids, proteins and nucleic acids are expected, resulting in tissue damage. Clinical manifestations of oxygen radical injury depend on a balance between tissue damage and repair [3].

Oxygen free radicals have been implicated as agents of cellular damage in many diseases associated with premature infants like necrotising enterocolitis, retinopathy of prematurity and bronchopulmonary dysplasia. The premature infants are developmentally unprepared to combat oxidative stress. High production of oxygen free radicals is partially dependent on the low levels of antioxidants including deficiency of Vitamin E [4]. Studies have also demonstrated that marked increase in antioxidant enzyme activities occur during the last 10-15% of gestation. These developmental changes will represent a preparation of life in an oxygen rich environment [5].

So the aim of the present study is to know the oxidant (MDA) and antioxidants (TAA and Vitamin E) levels in preterm and term infants and their mothers.

OBJECTIVE

To compare the cord serum concentration of oxidant (MDA) and antioxidants (TAA and Vitamin E) levels in Preterm and Term infants and their mothers.

MATERIALS AND METHODS

The study was conducted in a tertiary referral hospital, SSIMS and RC Davangere. In the present study 20 term infants of ≥ 37 weeks of gestational age and their mothers and 20 preterm infants of ≤ 36 weeks of gestational age and their mothers were studied. Only healthy mothers and their infants were included in the study. The gestational age, gender, birth weights, type of delivery, Apgar score at 5 minute were recorded. Mixed arteriovenous cord blood was collected in a clean sterile container at the time of delivery, allowed to clot for 30 minute and was centrifuged for 10 minute at 3000 rpm. Serum was separated and stored at -80^0 C until analysis was done. At the same time mother's blood was also collected and allowed to clot for 30 minute and was centrifuged for 10 minute at 3000 rpm and serum was separated and stored at -80^0 C till the analysis was done.

Inclusion criteria:

Healthy infants and their mothers with gestational age ≥37 weeks were taken as term infants. Infants and their mothers with gestational age ≤36 weeks were taken as preterm infants.

Exclusion criteria:

Pregnant women with history of gestational diabetes, ischemic heart disease, stroke, kidney disorders, and tobacco chewing and smoking were excluded from the study.

Statistical analysis was performed using student's unpaired't' test for assessment of mean difference between the groups.

Ethical clearance was obtained from the Institutional Ethical Committee and patient's informed written consent was taken.

Oxidative stress indicator, MDA was estimated by Thiobarbituric Acid Method [6].

Antioxidant, Vitamin E was estimated by Baker and Frank method [7] and TAA was measured by Fe^{+2} – EDTA complex reaction method [8].

All parameters were analyzed in a spectrophotometer.

RESULTS AND DISCUSSION

Table 1 shows the comparison of oxidant, total antioxidant activity and Vitamin E levels in preterm and term infants and their mothers

Pregnancy is a physiological state accompanied by a high-energy demand and an increased oxygen requirement. As a result, various compensatory adaptive changes occur with advancing pregnancy to meet the increasing demands of mother and fetus and the increased oxygen demand is met by increased ventilation. Thus these conditions may be responsible for increased oxidative stress in pregnancy [1].

Table 1: Comparison of oxidant, total antioxidant activity and Vitamin E levels in preterm and term infants and their mothers

Parameters	Preterm Infants (n = 20)	Term Infants (n = 20)	P value	Mothers of Preterm Infants (n = 20)	Mothers of Term Infants (n = 20)	P value
Oxidant (Malondialehyde (nmol/L)	1.34±0.77	0.77±0.24	0.003**	3.32±2.27	2.44±0.91	0.11
Total Antioxidant Activity (nmol/L	2.69±0.84	3.74±1.45	0.008**	3.41±0.86	4.48±1.24	0.003**
Vitamin E (mg/L)	10.13±1.11	12.32±3.22	0.007**	10.73±0.75	13.21±3.68	0.008**

1. Number in parenthesis indicates the number of samples in each group.
2. The values are expressed as their mean ± SD
3. Significance level * $p < 0.05$; ** $p < 0.01$.

The TAA is a dynamic equilibrium that is influenced by the interaction between each serum antioxidant constituents. TAA measures the low molecular weight chain-breaking antioxidant, excluding the contribution of antioxidant enzymes and metal binding proteins [8].

In this study TAA was decreased in preterm infants and their mothers as compared to term infants and their mother and also the TAA of cord blood was lower than their mother's blood and these findings were in accordance with other studies [1]. Low TAA could be indicative of increased oxidative stress or increased susceptibility to oxidative damage [8].

Plasma antioxidant activities alter progressively throughout pregnancy. Antioxidant Vitamins with the ability to stabilize highly reactive free radicals act as the first line of defense against free radical attack and lipid peroxidation [3]. It is elucidated from the study that birth weight of the newborn has effect on antioxidant status or vice versa, as poor antioxidant status is reflected in low birth weight infants [1].

Vitamin E is the major lipid soluble chain-breaking antioxidant in biological system and its lipid solubility allows its broad diffusion into the different tissues and cells. Thus, it exerts a major antioxidant effect in the body [4].

In our study Vitamin E was decreased in preterm infants and their mothers as compared to term infants and their mothers and these finding were in accordance with other studies [1,4]. As Vitamin E accumulates in the fetus during the 3rd trimester of pregnancy and thus preterm infants are predisposed to Vitamin E insufficiency [4]. The low values of Vitamin E seen in preterm infants may have consequential clinical importance [9].

In the present study the Vitamin E levels in cord blood were lower than their maternal blood as Vitamin E is limited transported from placenta and the reason for less transportation is still not clear [1,4].

Oxidative stress can be defined as increased formation of reactive oxygen species or decreased antioxidant defense system [10]. MDA is one of the fairly reactive metabolic products resulting from the effect of free oxygen radicals

on tissues and from a series of reactions during lipid peroxidation [6]. The serum MDA level is a sensitive marker of lipid peroxidation and thus of oxidative stress [3].

In our study MDA levels were increased in preterm infants and their mothers as compared to term infants and their mothers and were in accordance with other studies [3]. Newborn with low birth weight and their mothers showed relatively greater oxidative stress measured by their MDA levels [1].

In the present study the MDA levels in cord blood were lower than their maternal blood and were in accordance with other study [3]. The low cord blood MDA level is because of adequate placental barrier to shield the fetus from oxidative injury [3].

CONCLUSION

Our study concludes that there was an imbalance between oxidants and antioxidants levels resulting in an increased oxidative stress in Preterm infants and their mothers than in term infants and their mothers. Thus, this study helps in the prevention of prematurity related disorders of later life by supplementation of antioxidants during pregnancy especially for the high risk pregnancies prone for preterm deliveries.

CONFLICT OF INTEREST

Conflict of interest declared none.

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