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Research Article

Oxidative Stress and Antioxidant Status in Preeclampsia

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Abstract

Introduction and Aim: Pre-eclampsia is a pregnancy specific hypertensive condition with marked proteinuria. 3 to 10% of pregnancies are associated with pre-eclampsia. One of the causes that are related to pre-eclampsia is reported to be oxidant stress. Therefore, in the present study oxidant stress in pre-eclampsia is studied.

Materials and Methods: A case-control study was performed on 45 pregnant women with preeclampsia as cases and 30 normal pregnant women as controls, all at term (37 to 40 gestational weeks). The diagnosis of pre-eclampsia was based on the definition of American College of Obstetrics and Gynecologists.

Serum glutathione peroxidase (GPX) and superoxide dismutase (SOD), malondialdehyde (MDA) and Vitamin E were measured in the control as well as in pregnant women with pre-eclampsia. Routine standard methods were used to measure the parameters studied and subjected to relevant statistical analyses.

Results: The levels of oxidative stress markers GPX, SOD, and MDA in the controls and cases were shown in table 2. The antioxidant enzyme GPx and SOD were increased in the pregnant women with pre-eclampsia compared to the control subjects. MDA levels are also significantly increased in the pregnant women with pre-eclampsia. cases studied.

Conclusion: The preliminary study indicates that oxidant stress could be one of the factors that cause endothelial injury and may induce hypertension in pre-eclampsia.

Keywords: *Pre-eclampsia; Pregnancy; Oxidant Stress; Antioxidant Enzymes; MDA*

Introduction

Hypertensive disorders are common medical complications of pregnancy with a reported incidence of about 10% of first pregnancies and 20 - 25% of women with chronic hypertension [1]. Pre-eclampsia is a pregnancy-specific condition characterized by hypertension and proteinuria [2]. In pre-eclamptic women, lipoperoxidation products, especially malondialdehyde (MDA), increases [3] while enzymatic antioxidants superoxide dismutase (SOD), glutathione peroxidase (GPx) and nonenzymatic antioxidants (vitamins C and E) will decrease. During preeclampsia, levels of available nitric oxide (NO) in plasma and placenta decrease, while an increase in nitric oxide synthase (NOS) activity occurs [4].

Oxidative stress increases during pre-eclampsia and results in increased production of lipid peroxides, reactive oxygen species and superoxide anion radicals to cause endothelial injury and dysfunction, platelet and neutrophil activation [5,6]. In health, oxidation by free radicals and neutralization by antioxidants remain in balance. When the reactive oxygen species (ROS) are in abundance, oxidative stress occurs which is thought to be the causative factor in Pregnancy induced hypertension (PIH) [7].

The present prospective study was undertaken to observe the relative changes in oxidative stress markers (GPx, SOD, malondialdehyde) and antioxidant levels (Vitamin E) in pre-eclamptic and normal pregnant women.

Materials and Methods

A case-control study was performed on 45 pregnant women with preeclampsia as cases and 30 normal pregnant women as controls, all at term (37 to 40 gestational weeks). The diagnosis of pre-eclampsia was based on the definition of American College of Obstetrics and Gynecologists [8]. The study was approved by Institutional ethical committee. Informed consent was taken from all the subjects enrolled for the study.

Inclusion criteria for cases: Primigravida with diagnosed pre-eclampsia according to the definition of American College of Obstetrics and Gynecologists with an age ranging from 20 - 35 years.

Inclusion criteria for controls: Primigravida with normal BP (Blood pleasure), no proteinuria and without any other systemic or endocrine disorder. They were age matched with the cases.

Exclusion criteria: Patients with diabetes mellitus with or without treatment, obesity, severe anemia (Hb < 6 gm%), subjects suffering from any other systemic or endocrine disorders and patients with eclampsia were excluded from the study.

Serum glutathione peroxidase (GPX) and superoxide dismutase (SOD), malondialdehyde (MDA) and Vitamin E were measured. Whole blood GPX and SOD levels were measured using a commercially available kit (Ransel; Randox Laboratories Ltd., UK) according to the method of Paglia and Valentine [9,10]. Serum MDA levels were estimated by the method of Beuge., *et al.* [11] using thiobarbituric acid (TBA). Serum vitanmin E levels were measured by method of Baker H., *et al* [12].

Statistical analysis

The data was evaluated by using SPSS statistical package version 17.0. All Values are expressed as mean ± standard deviation of mean. Independent samples t-test (2-tailed) was used to find out the difference in the means of different parameters among the cases and controls. P value < 0.05 was considered as significant.

Results

The general characters of the controls and cases like maternal age, gestational age, Systolic Blood Pleasure (SBP) and Diastolic Blood Pleasure (DBP) were shown in table 1. The difference in the mean values of maternal age and gestational age were not significant between controls and cases with P- values 0.567 and 0.108 respectively. But SBP and DBP values were significantly high in cases when compared to that of controls (p- value < 0.001).

	Controls (n = 30)	Cases (n = 30)	P-value
Maternal age (years)	25.26 ± 3.57	25.76 ± 3.13	0.567
Gestational age (weeks)	38.23 ± 1.00	38.63 ± 0.89	0.108
SBP (mm of Hg)	116.8 ± 10.74	149.8 ± 6.17	< 0.001*
DB P (mm of Hg)	76.2 ± 7.35	113.93 ± 4.88	< 0.001*

Table 1: *General characters of cases and controls.*

**: Statistically significant.*

The levels of oxidative stress markers GPX, SOD, and MDA in the controls and cases were shown in table 2. The mean levels of the 3 stress markers were significantly higher in the pre-eclampsia group than in the control group. The mean GPX levels in cases and controls were 346.46 ± 71.01 (U/L) and 152.26 ± 22.12 (U/L) respectively. GPX levels in cases were significantly increased when compared to controls with p value < 0.001.

Parameter	Controls	Cases	P-value
Glutathione peroxidase (U/L)	152.26 ± 22.12	346.46 ± 71.01	< 0.001*
Superoxide dismutase (U/ml)	186.2 ± 34.26	386.46 ± 96.49	< 0.001*
Malondialdehyde (nmol/ml)	2.38 ± 0.72	4.66 ± 1.08	< 0.001*
Vitamin E (µmol/L)	7.07 ± 0.71	3.55 ± 0.30	< 0.001*

Table 2: *Circulating levels of oxidative stress and anti-oxidant markers in healthy pregnant-women and pregnant women with pre-eclampsia.*
** Statistically significant.*

The SOD levels in cases and controls were 386.46 ± 96.49 (U/ml) and 186.2 ± 34.26 (U/ml) respectively. The mean serum MDA levels in controls and cases are 2.38 ± 0.72 and 4.66 ± 1.08 nmol/ml respectively. MDA is significantly more in pre-eclampsia patients compared to controls (P < 0.001). There was a marked fall in antioxidant Vitamin E level in pre-eclampsia.

Discussion

Preeclampsia is a pregnancy specific, multisystem disorder that can have considerable adverse effects on both mother and fetus. More recently, antioxidants have been proposed as a potential preventive strategy on the basis of data suggesting that endothelial dysfunction is fundamental to the development of preeclampsia and that increased oxidative stress, particularly in the placenta, may contribute to endothelial dysfunction [9].

Impaired trophoblastic infiltration may be the trigger for the oxidant stress in the placenta. Repeated hypoxia and oxygenation may activate xanthine oxidase and NADP oxidase which generate superoxide radicals.

There is an imbalance between lipid peroxidation and antioxidant defenses in pre-eclampsia, leading to endothelial dysfunction and free radical-mediated endothelial cell injury [4,5]. Many studies confirm that levels of antioxidants such as vitamin C, vitamin E and other antioxidants are reduced in the sera and placentas of pre-eclamptic women [3-5]. The present study clearly indicates that significant rise in MDA with decreased vitamin E levels and altered serum lipid levels are possible causative factors for the pathogenesis of PIH. Hence early detection of these parameters is going to aid in better management of pre- eclampsia cases which is important to improve the maternal and fetal outcome in pre-eclampsia.

Conclusion

The proteinuria in preeclampsia is associated with glomerular injuries in the kidney, known as glomerular endotheliosis [12]. This is suggested to be caused by free radical damage as well as the release of free hemoglobin which may aggravate such an injury. The podocyte injury coupled with endothelial damage may cause hypertension in preeclampsia. Oxidative stress in general, and an imbalance in anti-oxidant and pro-oxidant status could play a key role in the pathogenesis of preeclampsia.

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