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Original Research Article

Stress and Lipid Peroxidation in Pregnancy and Associated Disorders

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Abstract

Background: Glutathione, superoxide dismutase, and Vitamin C, and E are antioxidants that are essential for all phases of pregnancy, including conception, fetal growth and development, labor, and postpartum health. They offer defense against oxidative stress, which is known to induce congenital abnormalities, abortion, and miscarriage, as well as protection against the harmful effects of pollutants, carcinogens, and teratogens on the developing fetus. Free radical production is a physiologically necessary process to counteract the oxidant effects of free radicals Numerous antioxidant defenses have developed in cells. These antioxidants are essential for avoiding oxidative stress in babies at risk of developing cystic fibrosis or in pregnant mothers with inflammation or illness states like diabetes and pre-eclampsia. Supplementing with antioxidants can lower the risk of birth abnormalities and shield moms and fetuses from the harmful and potentially deadly effects of pregnancy problems.

Aim: The aim of the current research is to assess the lipid peroxidation as malondialdehyde (MDA), enzymatic antioxidant activities like Superoxide dismutase & Catalase and non-enzymatic antioxidant activity i.e. ascorbic acid, alpha-tocopherol, uric acid along with lipid profile in the compared to non-pregnant women in the general population of pregnant women.

Material and Method: In the current research, the first group consisting of 50 healthy non-pregnant women were studied. The second group was age and socioeconomic status matched 50 healthy normal pregnant women. 100 pregnant women with iron deficiency anemia made up the third group. The last research group consisted of 35 pregnant women with moderate preeclampsia and 15 pregnant women with severe preeclampsia. The fourth group consisted of 50 pregnant women with gestational diabetes mellitus. All the study groups were assessed for serum MDA, Vitamin C, and E, Uric acid, lipid profile, Erythrocytic SOD, and Catalase.

Results: In the present study serum malondialdehyde (MDA) level was raised in normal pregnant women significantly. The Erythrocytic SOD was decreased significantly compared to non-pregnant women in healthy pregnant women. Ascorbic Acid shows a less significant decrease and α -tocopherol shows a highly significant decrease in the current study's typical pregnant ladies compared to non-pregnant women. Compared to non-pregnant women, typical pregnant women's serum uric acid changes insignificantly. When normal pregnant women are compared to non-pregnant women in the current study, total cholesterol, triglycerides, LDL cholesterol, and VLDL cholesterol all rise considerably, while HDL cholesterol does not alter appreciably.

Conclusion: Based on the findings of the current study, it can be deduced that iron deficiency anemia is linked to the production of free radicals, anomalies, and peroxidation of critical body components, increasing the danger for both pregnant women and fetuses. To evaluate

the status of antioxidants in pregnancy-related disorders, more extensive research is required. Pregnancy with gestational diabetes causes an oxidative stress situation that makes it simpler for membranes to be damaged by oxidation and lipoperoxidation.

Keywords: Adrenocorticotropin Hormone, Extra Cellular- Superoxide Dismutase, Reduced Glutathione, High-Density Lipoprotein-Cholesterol.

Introduction

The most frequently used medical word in use today is unquestionably less. Nowadays, it's common for people to express their tension through a complaint. Unfortunately, even while most people equate stress with negative, many people are unaware that stress may also be used positively, or that positive stress, or "eustress," can result from pleasurable circumstances. Even though it causes the same physiological changes in the body as harmful stress, it is nonetheless an enjoyable experience. However, under this circumstance, the body feels pleasure as opposed to any discomfort, and it even promotes more effective bodily functioning. In humor, stress has been called the "mother of all illnesses." [1]

The placenta's high concentration of mitochondria makes pregnancy particularly conducive to oxidative stress, which is defined here as an imbalance between pro-oxidants and antioxidants that favors the former and might cause harm. The second trimester of pregnancy is when oxidative stress rises. It is characterized by dynamic changes in multiple body systems resulting in increased basal oxygen consumption and changes in energy substrate used by different organs including the fetoplacental unit. From early pregnancy the human placenta influences maternal homeostasis; it is rich in mitochondria and when fully developed consumes about 1% of the basal metabolic rate of pregnant women. [2]

According to research conducted in India, the prevalence of gestational diabetes mellitus (GDM) and recognized diabetes was 1.19 and 0.56%, respectively. [3] According to the National Diabetes Data Group's standards, 4% of pregnant diabetes women had GDM. The fourth worldwide Workshop-Conference on Gestational Diabetes, however, revealed that 7% of pregnant women who are not diabetic also have GDM, totalling more than 200,000 cases yearly. [4]

Pregnancy difficulties including pre-eclampsia, gestational diabetes mellitus, and others magnify the biochemical changes that occur in the blood during a normal pregnancy. Oxidative stress and free radical generation can also result in birth abnormalities, abortions, and miscarriages. The supplementation with antioxidants protects the fetus and mother from the harmful effect of oxidant stress in fertility. [5]

At least half of all anemia occurrences in pregnant women have been linked to an iron deficit. The majority of the Indian population follows a vegetarian diet. Pregnancy-Induced Hypertension (PIH) is a condition of pregnancy-related hypertension that may or may not be accompanied by proteinuria and edema. Due to the multiple hormonal and metabolic changes that pregnancy brings about, it may be a condition that causes diabetes. When a woman is pregnant, a hereditary tendency to insulin resistance and/or insulin insufficiency may become briefly apparent. [6]

Despite extensive research and a wide range of treatment options, the prevalence

of iron deficiency anemia in pregnancy is still significant in underdeveloped nations like India. It has been established that oxidative stress is a key factor in the development of Iron Deficiency Anemia (IDA). [7] Additionally, it has been demonstrated that including synthetic antioxidants in the therapy of IDA reduces lipid peroxidation, stops pathologic development, and hastens the recovery of clinical symptoms. [8] The effects of antioxidants with oral iron to combat stress and side effects have been tried in both human subjects [9] and animals. [10]

Material and Methods

The Department of Biochemistry and the Department of Gynecology worked together on the current study in the hospital. All research participants provided their informed permission in both English and their native tongue.

Selection of Patients

To study, lipid peroxidation in pregnancy, a total of 200 samples were analyzed.

Study groups were divided into five categories;

Group 1 Non-pregnant healthy women (n=50)

Group 2 Normal pregnant healthy women (n=50)

Group 3 Pregnant women with iron deficiency anemia (n=50)

Group 4 Pregnant women with Gestational Diabetes Mellitus (n=50)

Lipid peroxide (MDA), Superoxide dismutase activity (SOD), Catalase, Vitamin- C and E, and other substances were examined in all of these patients. acid uric, Total cholesterol, triglycerides, HDL, LDL, and VLDL are all included in the lipid profile by different standard methods.

Age & Gestational age (2nd and 3rd trimester) match subjects of the same socioeconomic and nutritional status of healthy normal pregnancy & abnormal single tone pregnancy were selected from females reporting to Gynecology and Obstetrics Department.

Inclusion Criteria:

The cases having a past history of diabetes mellitus, hypertension, renal diseases, liver disorder, and with a history of multivitamin intake were excluded. Before beginning treatment with magnesium sulfate and hydralazine, samples of fasting venous blood were taken. All the normal and abnormal pregnancy subjects were proven by Gynecology and Obstetrics Department

Exclusion Criteria:

Women who had already received a diagnosis of anemia and were taking hematinics were not included in the trial. The normal pregnant subjects with obesity, Diabetes mellitus, under medication and untreated diabetes, hypertensive, severely anemic

Blood Sample Collection:

All individuals underwent venipuncture between the hours of 8 and 9 a.m. to obtain fasting blood samples (3 ml) in a variety of vials with or without anticoagulants depending on the parameter to be measured. Serum was separated by centrifugation of blood sample and preserved at 4ºC, then used for estimation of various parameters. Blood cells were washed 4 times with normal saline and lysate was prepared for the estimation of hemoglobin, SOD, and Catalase activity. All the parameters were assessed on UV-VIS Spectrophotometer 1240.

Methods

1. Estimation of Serum Malondialdehyde (MDA) Method - Buege and Aust, 1978[11].
2. Specific Activity of Erythrocytic Superoxide Dismutase (SOD) Method: Kakkar et al, 1984[12].

3. Estimation of Hemoglobin Method: Dacie J.V. et al, 1984 [13].
4. Estimation of Serum Vitamin E (Alpha-Tocopherol) Method: Baker and Frank, 1968 [14].
5. Estimation of Serum Uric Acid Method: CaraWay, W.T., 1963 [15].
6. Estimation of Total Cholesterol Method: Altair C.C., et al, 1974 [16].
7. Estimation of Triglycericles Method: Werener M, Gabrielson D.G. Estman (1981) [17].
8. Estimation of HDL-Cholesterol Method: Izzo C. et al, 1981 [18].

Statistical analyses: Data are given as the mean ± S.D. Differences between groups were analyzed, by using "two sample t-statistics under the basic statistical module", of "Minitab" software, the confidence of Interval was 95% Significant levels were always taken at 0.05.

Result

Table 1: Serum Malondialdehyde, SOD, catalase, Ascorbate, Serum alpha-tocopherol, Uric Acid, Total cholesterol, Triglyceride HDL-C, LDL-C and VLDL-C levels in Non-Pregnant & Normal pregnant women.

Number of Cases	Non-Pregnant Women	Normal Pregnant Women
MDA (nmol/ml)	1.29±0.53	1.65±0.46
SOD (U/g Hb)	656.4±39.5	562.2±27.4
Catalase (U/mg Hb)	5.09±0.69	4.18±0.75
Ascorbate (mg/dl)	0.88±0.10	0.79±0.06
α-Tocopherol (mg/dl)	0.92±0.07	0.47±0.03
Uric Acid (mg/dl)	2.22 ±0.66	2.54±0.72
Total cholesterol (mg/dl)	149.9±11.1	206.2±23.1
Triglyceride (mg/dl)	93.7±11.5	144.1±10.3
HDL-C(mg/dl)	45.4±6.21	55.2±9.0
LDL-C (mg/dl)	70.1±10.3	114.3±11.1
VLDL-C(mg/dl)	15.25±1.66	22.04±3.63

Table 2: Serum Malondialdehyde, SOD, catalase, Ascorbate, Serum alpha-tocopherol, Uric Acid, Total cholesterol, Triglyceride HDL-C, LDL-C, and VLDL-C in normal pregnant women and study groups.

S. N.	Number of Parameters	Pregnant women with anemia	Pregnant women with GDM	Pregnant women with preeclampsia
1.	MDA (nmol/ml)	2.44±0.52	2.37±0.52	3.13±0.58
2.	SOD (U/g Hb)	532.1±18.4	395.4±32.2	401.0±25.1
3.	Catalase (U/mg Hb)	4.80±0.53	4.09±0.79	4.29±0.35
4.	Ascorbate (mg/dl)	0.60±0.04	0.55±0.04	0.62±0.05
5.	α-Tocopherol (mg/dl)	0.53±0.04	0.66±0.2	0.42±0.06
6.	Uric Acid (mg/dl)	2.74±0.82	4.16±0.55	5.18±0.43
7.	Total cholesterol (mg/dl)	218.1±18.0	127.0±44.1	211.2±22.6
8.	Triglyceride (mg/dl)	128.5±32.1	139.1±19.3	161.3±14.2
9.	HDL-C(mg/dl)	54.17±6.37	60.3±8.2	64.5±7.5
10	LDL-C (mg/dl)	132.4±8.5	103.3±8.2	164.2±10.5
11	VLDL-C(mg/dl)	39.21±1.73	41.65±2.54	44.25±6.48

Significant increase in MDA and substantial decline in antioxidant activity,

both enzymatic and non-enzymatic shows an oxidative stress environment in normal pregnancy. Total cholesterol, triglycerides, HDL, LDL, and VLDL levels in the non-pregnant control group, respectively. The value of these parameters in normal pregnant women was highly significant increased change was observed.

Discussion

Pregnancy is a physiological state accompanied by a high energy demand and an increased oxygen requirement. Various compensatory adaptive changes occur with advancing pregnancy to fulfill the needs of the fetus (Gitto G et al, 2002) [19]. Such a condition may be responsible for raised oxidative stress in pregnancy. Oxidative stress is the presence of reactive oxygen species in excess of the buffering capacity of available antioxidants (Palan PR, 2001) [20]. Numerous human disorders, including preeclampsia, cancer, and atherosclerosis, have been linked to it. (Zhang C, 2001) [21].

The pathophysiology of many clinical illnesses is thought to include spontaneous responses such as lipid peroxidation and glycation. Elevated glucose concentrations accelerate protein glycation. However, iron deficiency anemia individuals who have never had diabetes have been shown to have higher amounts of glycated hemoglobin. Overall data show that lipid peroxidation can influence protein glycation (RC Sunderam, 2007) [22] Increase level of MDA in Gestational Diabetes Mellitus (GDM), was observed by Lalita chaudhari et al (2003) [23] and Bates et al (1997) [24]. A disturbance in glucose homeostasis characterizes the illness known as diabetes mellitus. Increased blood glucose levels have been shown to cause diabetes and oxidative damage (Tho LL, 1988) [25]. Malondialdehyde levels in patients with pre-eclampsia increase beyond normal pregnancy levels by the second trimester (Ishihara M et al, 1978 [27]; Maseki M et al, 1989 [26]. As a result, many other significant biomolecules, such as membrane lipids, can be oxidized. The pathophysiology of preeclampsia may include lipid peroxides and 98 free radicals (Sharma JB et al, 2004) [28].

Since it is widely established that ROS, particularly hydrogen peroxide (H2O2), blocks SOD function, decreased SOD activity in IDA may be related to increased oxidative stress (Isler M et al, 2002) [29].

In the current investigation, a substantial reduction in catalase activity was seen in preeclamptic patients compared to healthy pregnant women. The enzyme is known as catalase guards against the buildup of hydrogen peroxide in the cells by dismuting it into water and oxygen (Lenzi A. et al, 1993) [30]. Kumar and Das (2002) [31] discovered a declining tendency in vitamin C levels during the gestational period, however, the decline was not substantial in comparison to controls' levels.

It is generally recognized that vitamins C and E play a role in avoiding free radical damage, and pregnant women should make sure they are getting enough of these nutrients. Placental infection is made easier by ROS, and vitamin C deficiency impairs placental structure. As a result, there is a higher chance of early rupture of the membranes and premature delivery. (Dotsch et al, 200 [32]; Ilouno et al, 1996) [33].

The increase in uric acid may be a defensive reaction designed to counteract the negative consequences of oxidative stress and free radical activity. The insulin resistance syndrome is consistently characterized by elevated serum uric acid (Waring WS, 2001) [34].

Estrogen is the hormone that causes TG and HDL-C to be produced. Thus, hyper-estrogenemia and insulin resistance is to blame for hyperlipidemia in preeclampsia

(Kaaja R et al, 1995) [35]. In both our study and those of other researchers, a substantial increase in LDL-C levels was seen in pre-eclampsia when compared to controls. Pre-eclampsia is associated with an increase in autoantibodies against MDA-LDL and oxidized LDL. This increased lipid peroxidation contributes to the development of preeclampsia by causing foam cells to grow in the decidua. (Wakatsuki A et al, 2000) [36,37].

Conclusion

Antioxidant enzymes and antioxidant substances are the main components of human defense systems against oxidative stress and free radical damage. The body produces antioxidant enzymes (superoxide dismutase, catalase, and glutathione peroxidase), and it is difficult to change their levels. The amounts of antioxidant nutrients, however, may easily be changed by dietary or pharmaceutical supplementation. The idea that lower ascorbic acid -tocopherol and beta-carotene are used more often during both healthy and abnormal pregnancies suggests that antioxidant nutrients may have some protective benefits. It is tempting to hypothesize that in women who are likely to develop GDM and preeclampsia, appropriate antioxidant concentrations in the plasma or placental tissues may prevent the start or spread of free radical-mediated lipid peroxidation, preventing endothelial cell damage.

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