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ORIGINAL ARTICLE

Correlation between serum trace elements and risk of preeclampsia: A case controlled study in Riyadh, Saudi Arabia

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Abstract Preeclampsia is a serious medical complication during pregnancy. In response to an increasing number of preeclamptic cases and scarcity of data concerning the interrelation between trace element levels and preeclampsia, we carried out a hospital based case–control study in Riyadh, Saudi Arabia to study the correlation between levels of serum trace elements and risk of preeclampsia. One hundred and twenty pregnant women were enrolled in this study and divided into three groups of 40 each—Control group, HR group (women at high risk of preeclampsia) and PET group (Preeclampsia group). Serum trace element levels were estimated by inductively coupled plasma optical emission spectrophotometer. The analysis found that mean values of Ca, Mg and Zn were 90.08 ± 6.38, 19.33 ± 3.32 and 1.30 ± 0.83 mg/L respectively in normotensive control and 77.85 ± 4.47, 15.44 ± 1.43 and 0.98 ± 0.63 mg/L respectively in the HR group. The mean values of Ca, Mg and Zn in the preeclamptic group were 70.37 ± 4.66, 13.58 ± 1.98 and 0.67 ± 0.59 mg/L, respectively. Interelement analysis reflected a negative correlation between Ca and Mg and between Mg and Zn whereas positive correlation between Ca and Zn in preeclamptic women. However the correlation was not statistically significant. In conclusion, our study suggests that decreased levels of these trace elements in serum may act as predisposing factors in pathogenesis of Preeclampsia.

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1. Introduction

Preeclampsia is a common medical complication of pregnancy and is characterized by the hypertension, edema and proteinuria (Pallavi et al., 2012). It has a worldwide prevalence of 2–10% of pregnancies and one of the major causes of increase

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in maternal and perinatal morbidity and mortality. In Saudi Arabia, it accounts for 13,876 out of a population of 25,795,938 (Statistic by country, 2014). Preeclampsia is hemodynamically characterized by peripheral vasoconstriction which occurs due to imbalance of vasodilating and vasoconstrictor activity (Conrad et al., 1993). It is characterized by hypertension and proteinuria after 20 weeks of gestation.

Women of reproductive age are susceptible to both macro and micro nutritional deficiencies and the risk is increased in pregnant women due to increased requirements of nutrients like zinc, copper, calcium and vitamins etc., to fulfill the needs of the growing fetus (King, 2000). Essential trace elements are involved in various biochemical pathways. Their specific and the most important functions are the catalytic role in chemical reactions and in structural function in large molecules such as enzymes and hormones. Alterations in concentrations and homeostasis of each of these micronutrients in body are well-known contributors in pathophysiology of various disorders and diseases (Ulmer, 1977).

In muscle contraction and regulation of water balance in cells, calcium physiologically plays an important role. Changes in calcium levels of plasma lead to alteration of blood pressure (Manual for HIV-1 diagnosis, 2002). Magnesium is another important trace element; it acts as cofactor for many enzymes, required in various enzymatic processes, in proper bone formation and as an essential element to fetal development. Magnesium deficiency may possibly result in preeclampsia and preterm delivery which can lead to low birth weight. It is reported that during gestation, magnesium deficiency increases chances of neonatal mortality and morbidity (Sarma and Gambhir, 1995). Magnesium plays a significant role in peripheral vasodilation and in neurochemical transmission (Gibson, 1994). One of the potential causes of preeclampsia could be alteration of calcium and magnesium metabolism during pregnancy however, this role in pregnant women is still being discussed.

Zinc is associated with a number of biochemical pathways; as a co-factor in the synthesis of DNA, RNA and numerous enzymes (Pathak and Kapil, 2004). The deficiency of Zinc has been connected with fetal growth retardation, congenital abnormalities, complications of pregnancy and delivery. It is observed that during pregnancy there is reduction in levels of circulating zinc and as pregnancy progresses further reduction occurs, this may be due to less number of zinc binding proteins and enhanced transfer of zinc from mother to fetus.

Even though numerous studies have been carried out on preeclampsia, still the etiology of preeclampsia is not clear. Some of the studies reported that changes in metal levels of blood observed in preeclamptic patients may be associated with pathogenesis of preeclampsia, whereas, other studies have failed to show such association (Bringman et al., 2006; Caughey et al., 2005). This study was undertaken keeping in view the disparity in the findings of trace elements role in preeclampsia and additionally the scarcity of data on the preeclamptic women residing in Riyadh, Saudi Arabia. The present study is an extension of our previous work in which we reported abnormal kidney function tests in preeclamptic women (Noura et al., 2014). This study was carried out to add to better understanding of trace elements like calcium, magnesium and zinc and their role in etiology of preeclampsia and their correlation with basic clinical characteristics of the preeclamptic patients. The high risk group was included in the present work to study the scenario of levels of trace elements in this group. We thus hypothesize, that the altered homeostasis of these trace elements' levels in the high risk group of patients could help in prediction of preeclampsia during pregnancy.

2. Materials and methods

2.1. Study population

This study was carried out in collaboration with the Department of Clinical laboratory Sciences, King Saud University and Section of Obstetrics and Gynecology, King Saud Medical City Hospital, Riyadh from September 2012 to March 2014. The hospital's ethics committee has approved the study and informed consent was obtained from patients before blood sampling.

A total of one hundred and twenty pregnant women were enrolled in this study and divided into three groups of forty each: Control group – normal healthy pregnant women, HR group – pregnant women at high risk of preeclampsia and PET group – women with preeclampsia. All patients were attending antenatal care unit or labor room in their third trimester of pregnancy.

2.2. Inclusion criteria

Control group – Pregnant women with normal BP, absence of proteinuria, normal renal function and without any other systemic or endocrine disorder. All subjects included were in their third trimester (gestational age of $\geqslant$24 weeks).

High risk group – Women in the high risk group were included based on the following criteria: pregnant women with body mass index (BMI) of 35 or more, with mild hypertension or those with preeclampsia, gestational diabetes, IUGR (intrauterine growth restriction) or pre-term delivery in previous pregnancies and those with family history of preeclampsia.

PET group – Selection of the pre eclamptic group was according to the definition of American College of Obstetrics and Gynecologists (ACOG practice bulletin, 2002). Patients with renal dysfunction were also included.

2.3. Exclusion criteria

Patients with obesity, severe anemia or suffering from any hepatic dysfunction were excluded from the study.

2.4. Collection of blood samples and preliminary biochemical analysis

On admission, five milliliter of blood was drawn from each subject participated in the study in metal free sterile vacutainers. Blood samples obtained were then kept at room temperature for 30 min and centrifuged at 3000 rpm for 15 min to extract the serum. The serum samples were transferred in eppendorf tubes and stored at −80 °C until analysis. Basic biochemical tests including Complete Blood Count and Hematocrit (Hct) concentration were measured in auto analyzer Cell Dyne 3700 and platelet count was obtained using automatic reader, (STA compact, Mediserv, UK). Urine protein was measured and graded on a scale of 0–4+ (0, none; 1+,

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