



## Biochemical effect of pre eclampsia on serum calprotectin, ascorbic acid, Uric Acid and Calcium

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### ABSTRACT

Pre-eclampsia remains a leading cause of maternal and perinatal mortality and morbidity. It is a pregnancy-specific disease characterized by de-novo development of concurrent hypertension and proteinuria, sometimes progressing into a multi-organ cluster of varying clinical features. The aim of this work is to investigate whether calprotectin levels and Vitamin C in serum from women with pre-eclampsia differ from the levels in normotensive pregnant and non-pregnant women. Serum and plasma samples from 80 female, age 20 to 40 years , at the third trimester of pregnancy, (30-40 weeks). They were classified into 4 groups. The first group was the control group, it included 20 control non-pregnant healthy female subjects. The second group was the pregnant control group, it included 20 female subjects. The third group was the patient group, it included 20 pregnant women with preeclampsia . The fourth group included 20 pregnant women with sever pre- eclampsia for measuring serum calprotectin and serum vitamin C. At the gestational period of 20-24 weeks, serum calprotectin and uric acid were significantly elevated in pre-eclamptic patients compared to controls ( $P<0.05$ ). However, vitamin C and calcium were significantly decreased in preeclamptic patients compared to controls ( $P<0.05$ ).

**Keywords:** Preeclampsia, calprotectin, Vitamin C, Uric Acid, Calcium

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### 1. INTRODUCTION

**P**re-eclampsia is a serious complication of pregnancy characterized clinically by maternal hypertension and proteinuria. An insufficient trophoblast invasion into the maternal endometrium (decidua) leading to suboptimal development of the placenta with reduced placenta perfusion is assumed to be a predisposing factor for pre-eclampsia. The maternal symptoms are believed to be caused by maternal endothelial dysfunction associated secondary to release of substances shed from poorly perfused placental tissue (Roberts *et al.* 1989). Preeclampsia is a disorder of widespread vascular endothelial malfunction and vasospasm that occurs after 20 weeks' gestation and can present as late as 4-6 weeks postpartum. It is clinically

defined by hypertension and proteinuria, with or without pathologic edema. The incidence of preeclampsia in the United States is estimated to range from 2% to 6% in healthy, nulliparous women (Sibai, 2003, Vatten, 2004). The mechanisms by which preeclampsia occurs is not certain, and numerous maternal, paternal, and fetal factors have been implicated in its development. The factors currently considered to be the most important include the following, Maternal immunologic intolerance abnormal placental implantation, genetic, nutritional, and environmental factors, and cardiovascular and inflammatory changes (Cunningham *et al.*, 2010). Several investigators have shown that pre-eclampsia is associated with maternal leukocyte activation and because

calprotectin is derived predominantly from activated neutrophils and monocytes, it will be elevated in pre-eclampsia (Sacks *et al.* 1998). Pre-eclampsia is associated with the imbalance between lipid peroxides and antioxidant nutrients (Vit C & E). The imbalance favors lipid peroxides with the increasing severity of preeclampsia (Panburana *et al.*, 2000). Vitamin C is also known to contribute to immune homeostasis. Recently, it has been demonstrated that vitamin C has an inhibitory effect on the expression of pro-inflammatory cytokines such as interleukin (IL)-6 and tumor necrosis factor alpha, so that Vit. C may have a preventive role and decrease the risk & severity of pre-eclampsia (Petra *et al.*, 2007). Noyan *et al.*, (2006) found in his study that catalase (CAT) activity and ascorbic acid (Vit. C) were significantly higher in the pre-eclampsia and eclampsia groups than in controls the differences in Vit. C and CAT activity between the pre-eclampsia and eclampsia groups were not statistically significant, and the increased oxidative stress might contribute to the pathophysiological mechanisms of pre-eclampsia and eclampsia, they ascorbic acid (Vit. C) and catalase might have a protective role via free radical-scavenging properties. However, further study is needed. Uric acid is marker of oxidative stress, tissue injury and renal dysfunction, and therefore might be helpful in the prediction of complications of PE (Powers *et al.*, 2006). Uric acid is the end product of purine metabolism and is synthesized by the enzyme xanthine oxidase. Hypoxia and ischemia of the placenta and cytokines such as interferon induce the expression of xanthine oxidase and therefore increase the production of uric acid and also reactive oxygen species (Many *et al.*, 1996). In uncomplicated pregnancies, serum uric acid concentration fall in early pregnancy 25–35% due to an elevation in renal clearance secondary to increased glomerular filtration rate or reduced proximal tubular reabsorption and due to changes in its

production rate (Conrad and Lindheimer, 1999). Later in pregnancy the serum uric acid levels increase, possibly due to raised fetal production, decreased binding to albumin and a decline in uric acid clearance until toward the end of pregnancy when they approach non-pregnant values (Powers *et al.*, 2006).

## 2. MATERIAL AND METHODS

Blood samples were obtained from 80 female their ages ranged from 20 to 40 years. They were attendant of Benha university Hospital and Ain Shams Hospital for Gynecology and Obstetrics; they were classified into 4 groups. The first group represent control group, included 20 non-pregnant healthy female, The second group was the pregnant control group, included 20 pregnant female subjects, The third group was the patient group, included 20 pregnant women with pre-eclampsia and The fourth group represented by 20 pregnant women with sever pre-eclampsia. All subjects were asked to join the study and were informed about the aim of the work. The subjects were recruited from normotensive, pregnant >20weeks, non-smokers.

Mild Preeclampsia : was defined according to the American college of obstetricians and gynecologists (ACOG) terminology (Cunningham *et al.*, 2001) as hypertension  $\geq 140/90$  mmHg that developed after 20 weeks gestation and proteinuria  $\geq 1+$  in one dipstick measurement, in a midstream, clean-catch urine sample.

Severe PE was defined as: -Diastolic BP  $\geq 110$  mmHg, Significant proteinuria ( $\geq 2+$  in a dipstick measurement) and Presence of severity evidence as, persistent headache, visual disturbances, upper abdominal pain, or oliguria.

Exclusion Criteria: History of medical disorder e.g. renal, hepatic, immunological or diabetic disease. Present or past history of hypertension ( $>140/90$ ). Prenatal or postnatal diagnosis of a chromosomal or structural abnormality.

All subjects were followed up according to ANC protocol. All subjects were subjected for:

*2-1. Full History Taking Including:*

Personal history. Present history. Past medical and surgical history. Family history especially of hypertension, preeclampsia or eclampsia.

*2-2. Complete Physical Examination:*

This includes recording the vital signs , head neck examination, examination for cardiovascular diseases, liver and renal diseases, anemia, malnutrition or other medical or surgical illness. The patient is then weighed.

*2-3. Sample collection and storage:*

Blood sample were collected in dry clean test tubes incubated for 1/2 hr at room temperature to allow clotting for serum separation. Clear sera were separated by centrifugation at 3500 r.p.m . For 15 minutes and then collected in Eppendorf's tubes using automatic micropipettes. Serum samples were used immediately for

measuring Calprotectin assay procedure according to (*Dawson and Trapp, 1990*), Vitamin C assay procedure according to (*Jacota and Dani, 1982*) , *Uric Acid* assay procedure according to (*Schultz, 1984*). and *Calcium* assay procedure according to (*Quigley and Gottere., 1969* ) .

**3.RESULTS:**

Biochemical effect of pre eclampsia on calprotectin, Vitamin C, Uric Acid and Calcium in preeclamptic patients compared to normal pregnant and non-pregnant woman were statistically analyzed and represented in the table (1). The Table showed that the mean values of calprotectin and Uric Acid there were significant increase in mild and severe preeclampsia compared to controls ( $P < 0.05$ ). Also the Table showed that the Mean Value of Vitamin C and Calcium were significant decreased in mild and severe pre eclampsia compared to controls ( $P < 0.05$ ) and in severe pre eclampsia compared to mild pre eclampsia and to controls ( $P < 0.05$ ).

Table (1): Mean Value of Serum calprotectin, Vitamin C, Uric Acid and Calcium level of Pre-eclampsia cases compared with control pregnant and non pregnant healthy females.

Parameter test	Groups			
	Control (-ve) Non pregnant group	Control (+ve) pregnant group	Mild Pre-eclampsia group	Sever Pre-eclampsia group
Calprotectin(ng/ml)	161.30±6.95 <sup>b</sup>	106.80±5.36 <sup>a</sup>	305.25±6.87 <sup>c</sup>	306.10±8.18 <sup>c</sup>
Vitamin C (ug/ml)	3.73±0.12 <sup>c</sup>	3.58±0.13 <sup>c</sup>	2.76±0.16 <sup>b</sup>	2.19±0.13 <sup>a</sup>
Uric acid (mg/dl)	3.56±0.14 <sup>a</sup>	3.43±0.13 <sup>a</sup>	9.01±0.14 <sup>b</sup>	9.66±0.16 <sup>b</sup>
Ca (mg/dl)	10.96±0.15 <sup>d</sup>	9.82±0.13 <sup>c</sup>	8.56±0.43 <sup>b</sup>	7.62±0.13 <sup>a</sup>

SE: standard error. a, b & c: The difference in the superscript letters with the same row indicate significant difference ( $P < 0.05$ ).

#### 4. DISCUSSION.

Calprotectin is a cytosolic protein, predominantly found in neutrophil cells. It is a zinc- and calcium- binding 36 kD-protein belonging to the S- 100 family (Fagerhol *et al.* 1980). Calprotectin is released by activated neutrophils. Elevated levels of calprotectin in plasma have been found in inflammatory states, autoimmune diseases, and infections (Johne *et al.* 1997). As well as being a marker of inflammation, calprotectin has antimicrobial, cytotoxic, and cytokine- like effects, and is proposed to be an important mediator with regulatory functions in inflammatory reactions (Yui *et al.* 2003). pre-eclampsia is associated with maternal leukocyte activation . because calprotectin is derived predominantly from activated neutrophils and monocytes, its serum level can be elevated in pre-eclampsia (Barden *et al.* 1997, Gervasi *et al.* 2001). In this study there was a significant increase in the level of calprotectin in the serum of pre-eclamptic pregnant women than that of normal pregnant women and that of normal non pregnant women. The results were come in accordance with that of Braekke *et al.* (2005). This can be explained by leukocytic activation that occurs in pre-eclampsia (Gervasi *et al.* 2001). This may be a consequence or a cause of endothelial dysfunction that occurs in pre-eclampsia (Redman *et al.* 1999). Calprotectin is released from such activated leukocytes, and its serum level is elevated. (Braekke *et al.* 2005). Our results revealed that the mean value of vitamin C were significantly Decrease in mild and sever pre eclampsia compared to pregnant and non pregnant woman. Those results are concordant and agree with our study & those of the following: Kharb, (2000) who stated that there is significantly lower Vit. C plasma levels in pre-eclamptic group than control (Normotensive) as antioxidants may utilized to greater extent to counteract free radical-mediated cell disturbances; resulting in reduction in serum antioxidants

levels. Also Hubel *et al.*, (1997) reported that oxidative stress increased and plasma ascorbate concentration decreased in preeclampsia. While Milezarek *et al* (2000): stated that Vit. C act ai co-operative factors against lipid peroxidation in human placental mitochondria , as the inhibitory effect of Vit. C increased concentration,, also Mikhail *et al* (1994 & 1995 ). Uotila *et al* (1994 ), Symonds (1995), Morris *et al* (1996) Multo *et al* (1998). Stated that in preeclampsia, oxygen free radical - formation is incrcsed in blood (Zeeman & Dekker, 1992). peroxidation load in pre-eclampsia may reflect the severity of the disease. Indicating exhaustion of this compound in pr-eclampsia. agree with the findings of( Vlasselacr *et al.* (1992), who concluded that in severe pre-eclampsia antioxidant activity was decreased only when severe and was associated with intrauterine fetal growth retardation . whenever contradictory to that (Uotila *et al.* 1994) stated that the rise in antioxidant activity is probably of compensatory nature responding to the increase lipid. In this study, the Uric Acid level was increased in all cases of pre-eclampsia (mild, severe). Uric acid has received increasing attention as potentially relevant not merely as a marker of cardiovascular disease but as causally important (**Kang,2004**). Whether hyperuricemia, one of the earliest and most consistent findings in preeclampsia, is causally important is being re-evaluated. (**Roberts et al, 2005**). Furthermore Our results revealed that the mean value of calcium were significantly Decrease in mild and sever pre eclampsia compared to pregnant and non pregnant woman. It is hypothesized that low calcium intake may cause high blood pressure by stimulating the release of parathyroid hormone and/or renin, thereby increasing intracellular calcium concentration in vascular smooth muscle cells and causing vasoconstriction (Belizan, *et al.* 1988). A possible explanation for the mode of action of calcium supplementation is that it reduces parathyroid calcium release and

intracellular calcium concentration, thereby reducing smooth muscle contractility and promoting vasodilatation. Similarly, calcium supplementation could also reduce uterine smooth muscle contractility and prevent preterm labor and delivery (Villar, et al. 1990). On the contrary, (Zemel et al. 1990) did not observe any significant change in the basal levels of intracellular calcium in pre-eclamptic and normotensive patients during the course of pregnancy. However, they did observe that platelet intracellular calcium levels in pre-eclamptic women were more sensitive to arginine and vasopressin than those of normotensive pregnant women. Discriminant analysis indicated that the platelet intracellular calcium response to arginine and vasopressin during the first trimester was a significant predictor of subsequent development of pre-eclampsia.

## 5. CONCLUSION

Pre-eclampsia is a serious complication of pregnancy characterized by maternal hypertension and proteinuria. The etiology of pre-eclampsia is still uncertain, but an insufficient trophoblast invasion into the maternal endometrium (decidua) leading to suboptimal development of the placenta with reduced placenta perfusion is assumed to be a predisposing factor for pre-eclampsia. It could be concluded that there was increased in serum calprotectin level found in pre-eclampsia. It is thought that calprotectin may play a role in the development of pre-eclampsia. Moreover, serum uric acid seems to be a useful test to predict maternal complications in the management of women with pre-eclampsia. In patients with increased serum uric acid values labor should be induced, due to their increased risk of complications. Moreover the decreased of vitamin C level found in pre-eclampsia, As regards vitamin C (ascorbic acid); thus it is advisable for pregnant women to consume more of vitamin C containing nutrients and drug supplementation by vitamin C (tablets) all

through pregnancy. Also there was decreased of Calcium level found in pre-eclampsia, So daily supplementation with 2 grams of calcium during pregnancy significantly reduced the risk of pre-eclampsia and preterm labor in women with a baseline daily dietary calcium intake of less than 1000 mg. The treatment did not result in significantly improved obstetric and neonatal outcomes. If further research substantiates that calcium supplementation during pregnancy reduces perinatal morbidity or mortality with no long-term adverse effects, the dietary calcium intake of pregnant women could be increased at the community level.

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## الدراسة الكيميائية الحيوية لتأثير تسمم الحمل على بروتين الكالبروتكتين ومستوى فيتامين ج

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### الملخص العربي

مرض تسمم الحمل من الأمراض الخطيرة التي تصيب السيدات الحوامل، والذي يتم تشخيصه بارتفاع ضغط الدم وزيادة نسبة الزلال في البول وقد وجد أن هذا المرض يصيب حوالي 4 إلى 18% من السيدات الحوامل. ويعتبر مرض تسمم الحمل من الأمراض الخطيرة التي تصيب السيدات الحوامل، والذي يتم تشخيصه بارتفاع ضغط الدم وزيادة نسبة الزلال في البول وما زال السبب الحقيقي لتسمم الحمل غير مؤكد، ولكن من المحتمل أن يكون زرع التروفوبلاست في الغشاء المبطن للرحم ضعيفا، مما يؤدي إلى ضعف الدورة الدموية بالمشيمة، وهو أحد العوامل المؤدية إلى مرض تسمم الحمل. وبما أن لتسمم الحمل الكثير من الأعراض والمضاعفات التي قد تؤثر على الحامل وعلى الجنين تتكرر بعض الأبحاث العلمية لمحاولة التنبؤ المبكر بحدوث هذا المرض والتي أتفق معظم العلماء بأن أهم أعراضه هو ارتفاع ضغط الدم أكبر من 90/130 مم زئبق وتورم متماثل للطرفين السفليين وإفراز نسبة عالية من البروتين بالبول خلال 24 ساعة. في هذه الدراسة تم قياس الكالبروتكتين، فيتامين سي، وحمض البوليك و الكالسيوم في مصل 40 سيدة مصابة بتسمم الحمل، و في مصل 20 سيدة حاملا، و كذا في مصل 20 سيدات طبيعيات غير حوامل لوحظ في هذه الدراسة الآتي: ارتفاع مستوى الكالبروتكتين وحمض البوليك في مصل السيدات المصابات بتسمم الحمل عنه في مصل السيدات الحوامل طبيعيا، و كذا في مصل السيدات الطبيعيات غير الحوامل. انخفاض مستوى فيتامين جي و الكالسيوم في مصل السيدات المصابات بتسمم الحمل عنه في مصل السيدات الحوامل طبيعيا، و كذا في مصل السيدات الطبيعيات غير الحوامل. من هذه الدراسة نستنتج أن من الضروري متابعة نسبة بروتين الكالبروتكتين وحمض البوليك في أثناء فترة الحمل للكشف المبكر عن مرض تسمم الحمل. كما ان اعطاء الحامل فيتامين جي و كالسيوم يقلل من خطورة هذا المرض.

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