International Journal of Pharmacological Research
ISSN: 2277-3312
www.ssjournals.com
Journal DOI:10.7439/ijpr

Determination of Membrane intracellular and plasma magnesium and calcium concentration in preeclampsia: A cross sectional study

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Abstract
This is cross sectional study was done to determine the plasma concentrations of calcium, magnesium in women with, preeclampsia and in normal pregnancy. This study was carried in Ebn Siena Hospital, Khartoum. Fifty subjects were evaluate in this study, 25 preclampsia patients as cases and 25 healthy apparently as control groups. 50 pregnant women divided in two groups, group one diagnosed with preecalmpisa (diastolic blood pressure >90 mmHg; urinary albumin excretion >300 mgL), 25 patients, and group tow (25) as control. The age ranging between 35-55 years. This study carried in Ebn Siena Hospital, Khartoum state from February to May 2015, To investigate the plasma concentrations of calcium, magnesium in women with, preeclampsia and in normal pregnancy. Easylyte used to estimate Mg^{++}, Ca^{++} levels, the result found that a significant decrease in the plasma calcium concentration in the preeclamptic group compared to controls or healthy pregnant women ($P < .05$). Plasma magnesium concentrations were significantly lower in the healthy pregnant group and the preeclamptic group as compared to controls ($P < .000$).
Keywords: Preeclamptic, magnesium, Biochemical

1. Introduction
Pre-eclampsia is a multi-system syndrome that is exclusive to human pregnancy [1]. Pre-eclampsia is a disorder of human pregnancy that involves pregnancy-induced maternal hypertension and proteinuria [2]. It is one of the leading causes of maternal death [3]. Preeclampsia is a pregnancy-specific condition that increases maternal and infant mortality and morbidity. It is diagnosed by new-onset increased blood pressure and proteinuria during gestation.

Pre-eclampsia (PE) complicates 2%-8% of all pregnancies and is an important cause of perinatal morbidity and mortality worldwide. In order to reduce these complications and to develop possible treatment modalities, it is important to identify women at risk of developing PE. The use of biomarkers in early pregnancy would allow appropriate stratification into high and low risk pregnancies for the purpose of defining surveillance in pregnancy and to administer interventions. [4] Preeclampsia is a multisystem disorder associated with high maternal and perinatal mortality and morbidity. [5]

Biochemical markers in general and first trimester PE biochemical markers specifically. The main categories described are angiogenic/anti-angiogenic factors, placental proteins, free fetal hemoglobin (HbF), kidney markers, ultrasound and maternal risk factors. The specific biochemical markers discussed are: PAPP-A, s-Flt- placental growth factor (PGF), s-Endoglin, Placental Protein (PP13), cystatin-C, HbF, and α-microglobulin (A1M). Pregnancy-associated plasma protein A (PAPP-A) and HbF both show potential as predictive biochemical markers in the first trimester with 70% sensitivity at 95% specificity. However, PAPP-A is not PE-specific and needs to be combined with Doppler ultrasound to obtain the same sensitivity as HbF/A1M. Soluble Flt -1 and PlGF are promising biochemical markers that together show high sensitivity from the mid-second trimester. PlGF is somewhat useful from the end of the first trimester [6]. Other biochemical markers that have been used in diagnosis and monitoring of PE include serum creatinine and urate. These low molecular weight substances are used to monitor renal function in established PE. However, the usefulness of serum creatinine as a marker for glomerular filtration rate (GFR) is limited by the influence of an individual's muscle mass, by the tubular secretion and reabsorption, by dietary intake and by analytical difficulties [7]. Changes in intracellular calcium and magnesium concentrations seem to be involved in the pathogenesis of preeclampsia, whereas the role of cell membranes has not been studied in detail yet. [8] Magnesium sulfate ($MgSO_4$) has been used throughout the 20th century for prevention of eclamptic seizures and continues to be used extensively. Empirical evidence supports the effectiveness of $MgSO_4$ in preventing and treating eclamptic seizures, in addition to recent controlled clinical trials. For eclamptic seizure

prophylaxis in preeclamptic women, $MgSO_4$ is superior to phenytoin, nimodipine, diazepam, and placebo Magnesium is a unique calcium antagonist as it can act on most types of calcium channels in vascular smooth muscle and as such would be expected to decrease intracellular calcium. One major effect of decreased intracellular calcium would be inactivation of calmodulin-dependent myosin light chain kinase activity and decreased contraction [9]. The therapeutic use of intravenous Mg sulfate is universal, at least in the United States, for women with mild preeclampsia to prevent eclampsia seizures, and its effectiveness has been confirmed in a recent metaanalysis showing that parental Mg more than halves the risk of eclampsia [10].

Calcium is the most abundant mineral element in the body. About 98% of the 1200 g of calcium in the adult is in the form of hydroxyapatite in the skeleton. Hydroxyapatite is a lattice-like crystal composed of calcium, phosphorus, and hydroxide. The remaining calcium is in the extracellular fluid (50%) and in various tissues, especially skeletal muscle. Calcium is maintained within a fairly narrow range from 8.5 to 10.5 mg/dl (4.3 to 5.3 mEq/L or 2.2 to 2.7 mmol/L). Normal values and reference ranges may vary among laboratories as much as 0.5 mg/dl. This study was done to determine the plasma concentrations of calcium, magnesium in women with, preeclampsia and in normal pregnancy.

2. Materials and Methods

2.1 Study area

This research was recruited form Khartoum state.

2.2 Study Subjects

This cross sectional study 50 pregnant women divided in two groups, group one diagnosed with preecalmpisa (diastolic blood pressure >90 mmHg; urinary albumin excretion >300 mgL), 25 patients, and group tow (25) as control. The age ranging is between 35-55 years. This study carried in Ebn Siena Hospital, Khartoum state from February to May 2015, To investigate the plasma concentrations of calcium, magnesium in women with, preeclampsia and in normal pregnancy.

2.3 Inclusion Criteria

A total of 25 patients with preecalmpisa and 25 normal pregnancy women.

2.4 Exclusion Criteria

Patient who had other diseases.

2.5 Clinical investigation

Easylyte used to estimate Mg++, Ca++ levels.

2.6 Laboratory analysis

Calcium in the body is technically *ionized*, the term usually only applies to the free ionic fraction that is physiologically active in blood Easlyte cell back was used to estimate Mg++, Ca++ levels:

2.7 Statistical analysis

Statistical analysis was performed using statistical package for social science (SPSS), Descriptive and T-test.

3. Result

Table 1: Comparison of Serum Calcium Fractions between women with preeclampsia (patients) and normal pregnancy (control)

Measured units	Means ± SD		p- value
	Patients N =(40) mg/dl	Control N =(40)	
Ionized (free ions)	4.4	4.9	0.000***
Total diffusible	7.1	10.3	0.010**

*** Highly significant; ** significant

Table 2: Comparison of Serum Magnesium Ionized between women with preeclampsia (patients) and normal pregnancy (control).

Measured units	Means ± SD		p- value
	Patients N =(40) mg/dl	Control N =(40)	
Ionized (free ions)	2.1	1.12	0.000***

*** Highly significant

4. Discussion

There was a significant decrease in the plasma calcium concentration in the preeclamptic group compared to controls or healthy pregnant women ($P < .05$). Plasma magnesium concentrations were significantly lower in the healthy pregnant group and the preeclamptic group as compared to controls ($P < .000$). These results similar to E. W. Seely (2009) which reported Preeclamptic women also had lower serum ionized calcium than third trimester pregnant women.

References

[1] Redman CW, Sargent IL. Latest advances in understanding preeclampsia. *Science* 2005; 308:1592–1594.

[2] Gu V.Y., Wong M. H., Stevenson J.L., Crawford K.E., Brennecke S.P., Calreticulin in human pregnancy and pre-eclampsia, *Molecular Human Reproduction* 2008; 14 (5): 309–315.

[3] WHO. Make every mother and child count (2005). World Health Report Geneva: World Health Organization.

[4] Wu P, van den Berg C, Alfirevic Z, O'Brien S, Rothlisberger M, Baker PN8, Kenny LC, Kublickiene K, Duvekot JJ. Early Pregnancy Biomarkers in Pre-Eclampsia: A Systematic Review and Meta-Analysis. *Int J Mol Sci*. 2015 Sep 23; 16(9): 23035-56.

[5] Udenze IC, Arikawe AP, Azinge EC, Okusanya BO, Ebuehi OA. Calcium and Magnesium Metabolism in Pre-Eclampsia, *West Afr J Med*. 2014 Jul-Sep; 33(3):178-82.

[6] Anderson UD1, Olsson MG, Kristensen KH, Akerstrom B, Hansson SR,(2012), Biochemical markers to predict preeclampsia, *Placenta*. 2012 Feb; 33 Suppl: S42-7.

[7] Sherif Saleh, Anotonios Antoniou, Kevin Harrington, and Joseph Aquilina. Second Trimester Maternal Serum Cystatin C Levels in Preeclamptic and Normotensive Pregnancies, *Hypertension in Pregnancy*, 2010; 29:112–119.

[8] Barenbrock M, Louwen F, Hausberg M, Rahn KH, Kosch M. Membrane, intracellular, and plasma magnesium and calcium concentrations in Preeclampsia, *Am J Hypertens.* 2000 Jul; 13(7):765-9.

[9] Anna G. Euser, and Marilyn J. Cipolla. Magnesium sulfate treatment for the prevention of eclampsia: A brief review, *Stroke.* 2009; 40(4): 1169–1175

[10] Lawrence M. Resnick, Mario Barbagallo, Mordechai Bardicef, Orit Bardicef, Yoram Sorokin, Jeffrey Evelhoch, Ligia J. Dominguez, Brian A. Mason, David B. Cotton, Cellular-Free Magnesium Depletion in Brain and Muscle of Normal and Preeclamptic Pregnancy A Nuclear Magnetic Resonance Spectroscopic Study, hypertension, online September 7, 2016.

[11] Seely E W, Wood R J, Brown E M, and Graves S W (2009), Lower serum ionized calcium and abnormal calciotropic hormone levels in preeclampsia - See more at: http://press.endocrine.org

[12] David A. Goldstein. Walker HK, Hall WD, Hurst JW, Clinical Methods: The History, Physical, and Laboratory Examinations. 3rd edition. Boston: Butterworths; 1990. Chapter 143, pp 541.

[13] James M. Roberts, Judith L. Balk, Lisa M. Bodnar, Jose M. Beliza, Nutrient Involvement in Preeclampsia, *Journal of Nutrition* 2003; 45:514-24.