

Intracellular Magnesium and Ionized Calcium in Preeclampsia

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Abstract : Objective: Pre-eclampsia is one of the major causes of maternal and fetal morbidity and mortality(1). Though the aetiology is obscure, recent studies indicate that levels of magnesium and Calcium may have a role in pre-eclampsia. The aim of this study was to find out the relationship of intracellular magnesium levels and Ionized Calcium levels in pre-eclamptic pregnancies compared to normal pregnancies.

Materials and Methods: The blood samples from 100 pre-eclamptic women and 30 controls were analysed for Intracellular (RBC) magnesium levels and Ionized Calcium levels . Outcome of pregnancy was analysed in both the groups and compared.

Results : In this study there is a significant decrease in Intracellular Magnesium in preeclamptic pts compared to Normal Pregnant women($p < 0.05$). In Preeclampsia pts Intracellular Magnesium is 5.21mg/dl, with cut off value being 6.36mg/dl with sensitivity of 99% and specificity of 96.6%. Ionized Calcium levels in preeclampsia pts is 1.42mmol/L, with cut off value of 1.37mmol/L, sensitivity is 95%, specificity is 98% ($p < 0.05$)

Conclusion: Intracellular Magnesium is significantly decreased where as Ionized Calcium is increased in preeclampsia pts compared to normal pregnant women , suggesting the possible role of Intracellular Magnesium and Ionized calcium in etiopathophysiology of Pregnancy Induced Hypertension. Ionized Calcium estimation will easiest ,cost effective parameter to assess Preeclampsia.

Keywords: Preeclampsia, intracellular Magnesium, Ionized calcium.

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I. Introduction

Hypertension is the second most common cause for maternal mortality. It is estimated upto 30% of perinatal deaths are related to Hypertensive disorders of Pregnancy.

Pre-eclampsia is one of the most common causes of maternal and fetal morbidity and mortality [2]. It is a systemic disease that affects about 5 – 7 % of all pregnancies and is the most common, yet least understood disorder of pregnancy [3]. It is a rapidly progressive condition characterized by high blood pressure, platelet aggregation, swelling of the lower extremities and protein in urine [4]. Sudden weight gain, headaches and changes in vision are important symptoms. Typically blood pressure elevations and pre-eclampsia occur in the late second trimester or third trimester [5]. The pathophysiological mechanism is characterized by a failure of the trophoblastic invasion of the spiral arteries which may be associated with an increased vascular resistance of the uterine artery and a decreased perfusion of the placenta [2]. The incidence is about 6% in primigravida women [6]. Clinically pre-eclampsia is characterized by persistently elevated blood pressure of greater than 140/90 mmHg, proteinuria and oedema [7]. It may be associated with complications like visual disturbances, oliguria, eclampsia, hemolysis, elevated liver enzymes, thrombocytopenia, pulmonary oedema and fetal growth restriction [8]. Early detection and prompt management helps in reducing the complications of this condition. Despite its prevalence and severity, the pathophysiology of this multisystem disorder is still poorly understood and its aetiology has not yet been fully elucidated [9]. Environmental and nutritional factors may play a role in the aetiology of pre-eclampsia.

Magnesium is the 4th common cation in the body, necessary for 300 enzyme systems [10]. Decreased intracellular Mg would result in partial membrane depolarization and decreases repolarization in association with cellular accumulation and potential Calcium dependent cell actions [11,12]. Calcium plays an important role in muscle contraction and regulation of water balance in cells. Modification of plasma calcium concentration leads to the alteration of blood pressure. The lowering of serum calcium and the increase of cellular calcium can cause an elevation of blood pressure in pre-eclamptic mothers. The increase of cellular calcium concentration when serum calcium went lower led to constriction of smooth muscles in blood vessels and increase of vascular resistance [13].

II. Materials and Methods

Study is conducted in two groups includes 30 [n=30] healthy pregnant women aged between 20 -30yrs [controls] who were non diabetic, nonhypertensive with no renal disease. Group-2 comprises 100[n=100] pregnant women with in the age group of 20-30yrs with preeclampsia having BP140/90mmof hg edema being present. In these pts BP was normal during first 20 wks of gestation. No h/o of previous HTN and renal disease. All women in both the groups were in same gestational age (24-34wks)

Methods

3ml of venous blood is collected in clean sterile bottle, out of that 2ml washed with normal saline, centrifuged, lysed and intracellular magnesium level is estimated by Calmagite method, Ionized calcium is estimated in serum by ISE (ion selective Electrode) method.

III. Results

Mean value of Intracellular magnesium group 2 [preeclampsia] is 5.21mg/dl, group1 [controls] is 6.3mg /dl ($p<0.05$). Mean value of Ionized Calcium in preeclampsia pts is 1.42mmol/L and in controls 1.31mmol/L ($p<0.05$) [table 1]

Table:1

Groups	RBC Mg	Ionized Cal	P value
Group -1 (Pre eclampsia)	5.21mg/dl	1.42mmol/L	0.05
Group-2 (control)	6.3mg/dl	1.31mmol/L	0.05

Table 2:

Parameter	Cut off value	Sensitivity	Specificity	Diagnostic efficiency
RBC Mg	6.36mg/dl	99%	97%	98%
Ionized Calcium	1.37mmol/L	96%	95%	97%

The cut off value is calculated by taking the mean of controls and subtracting 2SD

Sensitivity = $TP/TP+FN \times 100$

Specificity = $TN/FP+TN \times 100$

Diagnostic Efficiency = $TP+TN/Total \text{ no of pts evaluated}$

Table:2 suggests that the cut off value of RBC Mg is 6.36mg/dl, sensitivity is 99%, specificity is 97%, diagnostic efficiency is 98%.

The cut off value of ionized calcium is 1.37mmols/L, sensitivity is 95%, Specificity is 95%, Diagnostic efficiency

IV. Discussion

Preeclampsia is a specific syndrome of reduced perfusion, secondary to vasospasm and endothelial activation with edema, BP-140/90mm of Hg, after 20 wks of gestation and most frequently near term [14].

Magnesium acts as calcium antagonist via calcium channels, regulation of energy transfer, membrane stabilization, Mg has a depressive effect at synapses and has been used as an anticonvulsant. The mechanism of action of synapses is related to competition between Calcium & Mg in the stimulus secretion process in transmitter release.

The most well described of these is presynaptic inhibition of acetylcholine release at neuromuscular junction. Its action as an anticonvulsant is secondary to Mg antagonist at Methyl D aspartate (NMDA) receptors. Stimulation of which is known to lead to excitability of post synaptic potential (EPSP) causing seizures. Mg has been successfully used as an anticonvulsant in eclampsia [15]. Experimentally Mg has been shown to block the NMDA subtype of glutamate channel through which the calcium enters the cell and causes neuronal damage during cerebral ischemia [10]. Ischemia leads to lowering of transmembrane potential, allowing calcium influxes. Membrane phospholipids are hydrolysed by activated enzymes. Magnesium blocks Calcium at intracellular sites in addition to the outer lipid membrane. Pathological findings from brains of pts with eclampsia reveal evidence of vasospasm, the finding has been backed by cerebral angiography and CT findings and agree with findings in the systemic vasculature [16].

V. Conclusion

In the present study the level of Intracellular Magnesium is decreased, whereas Ionized Calcium is increased. Ionized calcium can be considered as a relatively better parameter to assess Preeclampsia and Eclampsia, compared to Mg as estimation of RBC Mg is a tedious process and time consuming. The patients' samples can be sent to Biochemistry lab along with electrolytes assessment and Ionized Calcium can be estimated. Assessing Ionized Calcium can be useful in preventing Eclampsia which is harmful to the patients.

References

- [1]. WHO. The hypertensive disorders of pregnancy WHO tech, *Rep ser.* 1987;758:93-4.
- [2]. Sukonpan K, Phupong V. Serum calcium and serum magnesium in normal and pre-eclamptic pregnancy. *Arch Gynecol Obstet.* 2005;273:12-6. [[PubMed](#)].
- [3]. Ziaei S, Ranjkesh F, Faghihzadeh S. Evaluation of 24-hour copper in pre-eclamptic vs normotensive pregnant and non-pregnant women. *Int J Fertil Steril.* 2008;2:9-12.
- [4]. Sarsam DS, Shamden M, Al Wazan R. Expectant versus aggressive management in severe pre-eclampsia remote from term. *Sing Med J.* 2008;49:698. [[PubMed](#)].
- [5]. Akinloye O, Oyewale OJ, Oguntibeju OO. Evaluation of trace elements in pregnant women with pre-eclampsia. *Afr J Biotechnol.* 2010;9(32):5196-5202.
- [6]. Kumru S, Aydin S, Simsek M, Sahin K, Yaman M, Ay G. Comparison of Serum Copper, Zinc, Calcium and Magnesium Levels in Pre-eclamptic and Healthy Pregnant Women. *Biol Trace Elem Res.* 2003;94:105-12. [[PubMed](#)].
- [7]. American College of Obstetrics and Gynaecology (ACOG) Practice bulletin. Diagnosis and management of pre-eclampsia and eclampsia. *Obstet Gynaecol.* 2002;99:159-67.
- [8]. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Gilstrap LC III, Wenstrom KD. *Williams Obstetrics. 22nd ed. New York: McGraw-Hill; pp. 761-808.*
- [9]. Bringman J, Gibbs C, Ahokas R. Differences in serum calcium and magnesium between gravidas with severe pre-eclampsia and normotensive controls. *Am J Obstet Gynecol.* 2006;195:148.
- [10]. Borzeix MG-Akimjak JP, Charles P, Lenfant M, Cohn R. Effect of magnesium on GABA inhibition induced convulsion in mice. *Ecd. Magnesium, London John Libbey 1995, 177-180. (1993)*
- [11]. Classen HG, Speich M, Schimats Chek, HF and Rattanarayaram W. *ibid., 13-20 (1994)*
- [12]. Lawrence M, Resnick, Mario Barbagalla. Cellular-free magnesium depletion in brain and muscle of normal and preeclampsia pregnancy. *Hypertension* 44;2000(2004)
- [13]. Sukopan K, Phupong V. Serum Calcium and serum MG in Normal & Preeclamptic pregnancy. *Arch Gynecol Obstet.* 2005;273:12-6 ([PubMed](#))
- [14]. F. Cunningham, Kenneth Leveno, Steven Bloom, McGraw Hill Professional. William A. *Text book of Obstetrics, Edition 22, Sec VII, pp. 763-765, (2005)*
- [15]. The Eclampsia trial collaborative group. Which anti-convulsant for women with preeclampsia. *Evidence from the collaborative eclampsia trial. Lancet, 345, 1455-63. (1995)*
- [16]. Lewis KL, Hinshaw DB, Will AD, Hasso AN, Thompson JR. CT and angiographic correlation of severe neurological disease in toxemic of pregnancy. *Neuroradiology, 30:59-64. (1980).*

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