



ISSN NO. 2320-5407

Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/3378
DOI URL: <http://dx.doi.org/10.21474/IJAR01/3378>



INTERNATIONAL JOURNAL OF
ADVANCED RESEARCH (IJAR)
ISSN 2320-5407
Journal homepage: <http://www.journalijar.com>
Journal DOI:10.21474/IJAR01

RESEARCH ARTICLE

SERUM TOTAL CALCIUM, MAGNESIUM, SODIUM AND POTASSIUM IN SUDANESE WOMEN WITH PREECLAMPSIA.

Mohammed Abdalla Elhassan Sidahmed^{*1}, Nuha Eljaili Abubaker² and Ghada A Elfadil³

1. Elneelin University, College of medical Laboratory Science.
2. Sudan University of Science and Technology, College of medical Laboratory Science.

Manuscript Info

Manuscript History

Received: 17 December 2016
Final Accepted: 20 January 2017
Published: February 2017

Abstract

Preeclampsia is characterized by new-onset hypertension, proteinuria and is responsible for substantial maternal and fetal morbidity. The electrolytes like sodium, potassium and chloride contribute significantly in the functioning of the vascular smooth muscles and may play an important role in hypertension.

This study was carried out to measure serum levels of sodium, potassium, magnesium and calcium in preclamptic women. Sixty blood samples were collected from patients in period between June to October 2016, chosen from Omdurman Maternal hospital (thirty of them used magnesium sulfate as supplement and thirty not used supplement) and sixty normal pregnant women as control.

Serum sodium and potassium were measured by using ion selective electrode (Easylyte), while serum magnesium and serum calcium were measured by using Mindray 380

The study showed that, women with preeclampsia had significantly lower levels in means serum total calcium, magnesium, and potassium (7.34 ± 0.51 mg/dL) vs. (8.58 ± 0.71 mg/dL) $P < 0.05$, (1.29 ± 0.23 mmol/L) vs (1.83 ± 0.32 mmol/L), and (3.08 ± 0.24 mmol/L) vs 3.55 ± 0.34 mmol/L) p value < 0.05 respectively. There was significant increase in mean of serum sodium in women with preeclampsia compared to control group (144.57 ± 3.93 mmol/L) vs (138.27 ± 3.8 mmol/L) p value < 0.05

There was significantly positive correlation between serum magnesium in preclamptic women used magnesium sulfate and preclamptic women not used magnesium sulfate ($r = 0.3 / p = 0.049$), while there were weak negative correlations between serum calcium and potassium in these two groups.

Copy Right, IJAR, 2017,. All rights reserved.

Introduction:-

Hypertensive disease of pregnancy (HDP) is one of the most common complications of pregnancy, occurring in 5-8% of the pregnancies⁽¹⁾. Hypertensive disorders are the second most common cause of maternal deaths worldwide⁽²⁾. There are several major categories of hypertensive disorders in pregnancy ranging from mild to moderate rise in blood pressure without proteinuria (usually called pregnancy induced hypertension (PIH)), preeclampsia (hypertension with proteinuria), severe preeclampsia and eclampsia⁽³⁾. Maternal hypertension, even of the mild to

moderate category, can lead to adverse perinatal outcomes like low birth weight, pre-maturity, stillbirth and intrauterine growth retardation ⁽⁴⁾.

Hypertension results primarily from the interplay of internal derangements (primarily in the kidney) and the external environment. Sodium, the main extracellular cation, has long been considered the pivotal environmental factor in the disorder. Numerous studies show an adverse effect of a surplus of sodium on arterial pressure ^(5, 6). By contrast, potassium, the main intracellular cation, has usually been viewed as a minor factor in the pathogenesis of hypertension. However, abundant evidences indicates that potassium deficit has a critical role in hypertension and its cardiovascular development ^(7,8).

Calcium plays a critical role in the function of the cardiac and vascular smooth muscles. It is known that the deficiency of calcium may lead to irritable nervous muscular symptoms, even tetanic convulsions, bleeding diathesis, capillary haemorrhages, tissue exudation and osteomalacia. These features have got some resemblance to the clinical manifestations and pathological findings in pregnancy induced hypertension (PIH), particularly eclampsia. Increase in the intracellular calcium causes vasoconstriction, increase in the peripheral resistance and therefore, an increase in the blood pressure ⁽⁹⁾. Magnesium modulates the cardiovascular effect of sodium and potassium and it is the cofactor for the sodium potassium ATPase activity ⁽¹⁰⁾. Since the electrolytes: calcium, magnesium, sodium and potassium contribute significantly in the functioning of the vascular smooth muscles, the present study was designed to evaluate the role of these electrolytes in the genesis of PIH.

Materials and Methods:-

Study Population: The study was carried out at College of Medical laboratory Sciences, and the subjects were recruited from Omdurman Maternal hospital, in Khartoum(Sudan) from June to October 2016. A total of 120 pregnant women were enrolled in this study ; divided into three groups, 60 healthy normotensive pregnant women (Control group), 30 pregnant women with preeclampsia , and 30 women with preeclampsia under magnesium sulfate as treatment. The study was approved by hospital's ethics committee. Informed consent was obtained from patients before blood sampling.

Inclusion criteria:-

Patients with an onset of hypertension more than 140/90 mmHg during the second or third trimester of pregnancy, Excretion of more than 300 mg of urinary Protein per 24 hrs, edema, Patients with or without convulsions .

Control- pregnant women with normal Blood Pressure , absence of proteinuria and without any other systemic or endocrine disorder and age-matched with the cases. All subjects included were in their third trimester (gestational age of ≥ 24 weeks).

Exclusion criteria Patients with congestive heart failure, Diabetes mellitus, kidney disease, thyroid and parathyroid disorders, cirrhosis of the liver , alcoholics and any other systemic disease were excluded from the study.

Blood sample and Analysis:-

About 2ml of venous blood was collected from the antecubital vein by taking aseptic precautions. Care was taken to prevent venous stasis during the sample collection. The blood was allowed to clot and the serum was separated by centrifugation. The estimation of the parameters was carried out within 4-6 hrs. The samples were analyzed for serum total calcium by the O-Cresolphthaleincomplexone method ⁽¹¹⁾, serum magnesium by the calmagite dye method ⁽¹²⁾ and for serum sodium and potassium by Electrolyte analyzer (**easlyte**). The internal control sera of two different levels were used to calibrate the instruments.

Data was analyzed using SPSS computer program, the mean and standard deviation were obtained and the independent 't.test' used for comparison (p value of ≤ 0.05) was considered significant.

Results:-

The mean age of the preeclamptic patients was 29.4 ± 5.2 years (range 19-40) , while in preeclamptic group under magnesium sulfate treatment with magnesium sulfate was 29.2 ± 4.9 year, and in control group was 29.6 ± 4.6 years with p value (0.89, 0,78 respectively) .

In comparison with the controls, women with preeclampsia had significantly lower in means of serum total calcium, magnesium, and potassium (7.34±0.51mg/dL) vs. (8.58± 0.71mg/dL) P<0.05, (1.29±0.23mmol/L) vs (1.83±0.32 mmol/L), and (3.08±0.24 mmol/L) vs 3.55±0.34 mmol/L) p value <0.05 respectively . There was significant increase in mean of serum sodium in women with preeclampsia compared to control group (144.57±3.93 mmol/L) vs (138.27±3.8 mmol/L) p value <0.05 as in table 1.

Table1: means comparisons of serum calcium, magnesium, sodium and potassium in preeclamptic women compared to control group.

Variable	Patients (mean ± SD) N=60	Control (mean± SD) N=60	P-value
Calcium (mg/dL)	7.34± 0.51	8.5± 0.71	0.000
Magnesium(mg/dL)	1.29±0.23	1.83±0.32	0.032
Sodium(mmol/L)	144.57±3.93	138.27±3.80	0.000
Potassium(mmol/L)	3.08±0.24	3.55±0.34	0.041

Results expressed as Mean ±SD and significant differences considered as p-value ≤0.05.

Table 2: means comparisons of serum total calcium, magnesium, sodium and potassium in preeclamptic women used magnesium sulfate compared to preeclamptic women not used magnesium sulfate.

Variable	Preeclamptic women used magnesium sulfate N=30	preeclamptic women not used magnesium sulfate N=30	P-value
Calcium (mg/dL)	7.3± 0.5	8.01± 1	0.000
Magnisium(mg/dL)	3.0 ± 0.8	1.3± 0.2	0.000
Sodium(mmol/L)	136.4± 4.7	144.7 ±3.9	0.02
Potassium(mmol/L)	3.3 ± 0.3	3.08 ± 0.2	0.04

Results expressed as Mean ±SD and significant differences considered as p-value ≤0.05.

In comparison with preeclamptic women used magnesium sulfate with preeclamptic not used magnesium sulfate there was significantly increased in serum magnesium (3.0 ± 0.8 mg/dL) vs (1.3± 0.2 mg/dL) with p value (0.00), while there were significantly decrease in serum sodium, and calcium as in table 2

There was significantly positive correlation between serum magnesium in preeclamptic women used magnesium sulfate and preeclamptic not used magnesium sulfate (r= 0.3 / p= 0,049) as in fig 1, while there were weak negative correlations between serum calcium and potassium as in fig (2, 3)

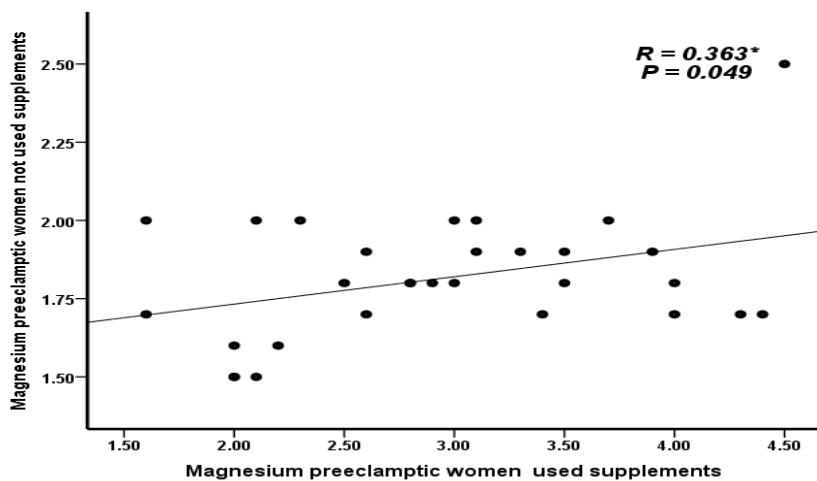


Figure 1:- Correlation between Mg level in Preeclamptic women used and not used magnesium sulfate. P-value <0.05 consider as significant.

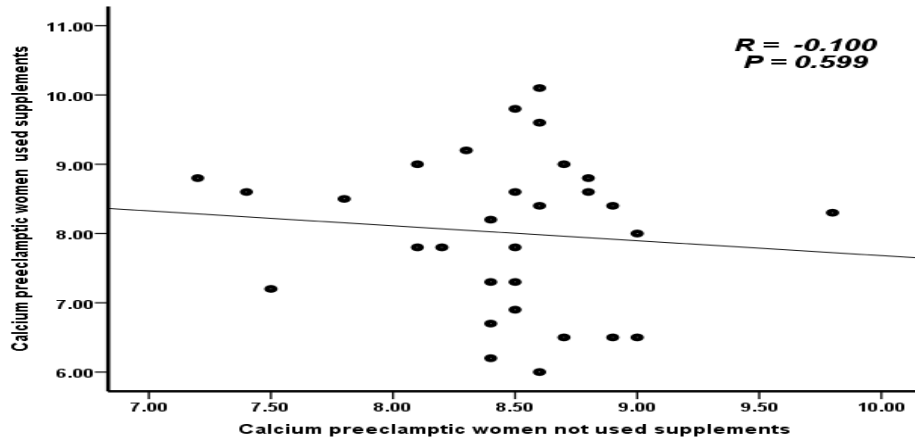


Figure 2:- Correlation between serum calcium level in Preeclamptic women used and not used magnesium sulfate. *P-value*<0.05 consider as significant.

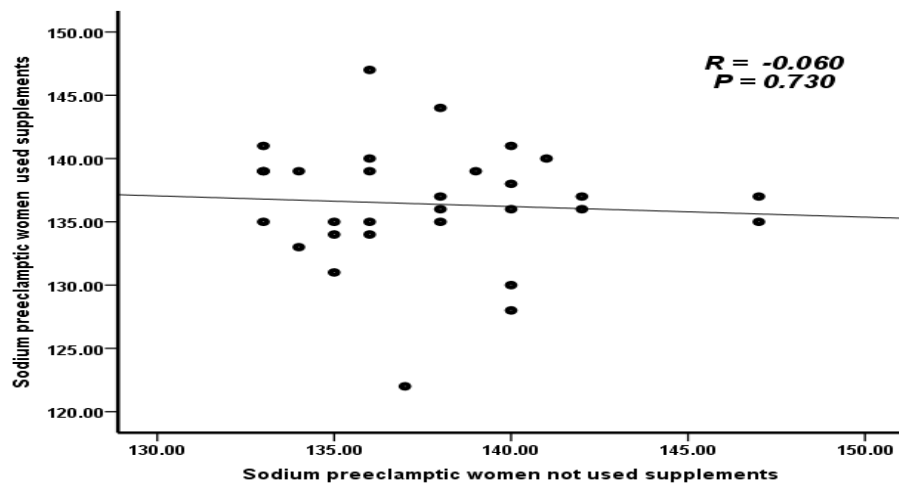


Figure 3:-Correlation between Na⁺ level in Preeclamptic women used and not used supplement. *P-value*<0.05 consider as significant.

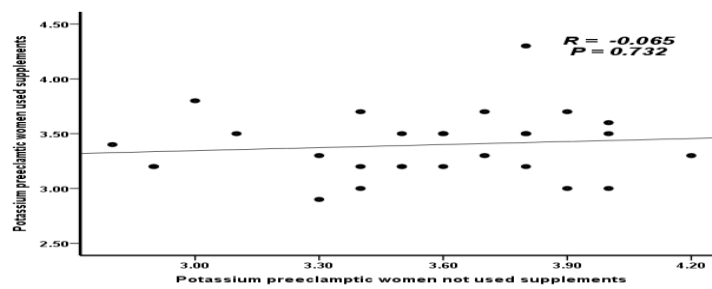


Figure 4:- Correlation between K level in Preeclamptic women used and not used supplement. *P-value*<0.05 consider as significant.

Discussion:-

Preeclampsia is a multi-factorial process and multi organ dysfunction with no individual factor strictly essential or sufficient for causing it. The numerous complications associated with it have triggered a phobia in pregnant women (13).

From the finding of this study it appears that serum levels of calcium, magnesium and potassium were significantly decreased and the serum level of sodium was significantly increased in preeclamptic women group compared to control group (p, value=0.000). This result agreed with study carried by many authors^(14,15,16,17), which showed that; Low serum calcium may cause high blood pressure by stimulating parathyroid hormone and rennin release which in turn increases intracellular calcium in vascular smooth muscle. This causes vasoconstriction, increase of vascular resistance and rise in blood pressure in preeclamptic women. Magnesium is known to increase the prostacyclin release from the endothelial cells of blood vessels, which acts as potent vasodilator. Like Calcium ion, lowered Mg²⁺ levels are thought to potentiate contractile response of vascular smooth muscle to vasopressor. An increase in renal clearance during pregnancy may contribute to the reduction in serum Mg²⁺. In addition Mg²⁺ depletion increases the vasoconstrictor effect of angiotensin II and noradrenaline. Mg²⁺ also has a substantial beneficial effect in preeclampsia for the prevention and treatment of convulsions. Potassium deficit in body is as a result of inadequate conservation of potassium by kidney and alimentary canal, fecal potassium losses can exceed even urinary losses.⁽¹⁸⁾ Hypokalemia in preeclampsia may be due to abnormality in the transport of sodium and potassium across the vascular smooth muscle cell membrane, which is normally responsible for the maintenance of blood pressure.⁽¹⁹⁾

The precise mechanism of sodium retention in preeclampsia is not clear, though the retention is likely due to vasoconstriction leading to reduction of glomerular filtration rate and stimulation of rennin-angiotensin-aldosterone mechanism. The net effect is decreased intracellular fluid and increased extracellular fluid volume.⁽²⁰⁾

Also the findings of this study showed that, there was significant increase in blood pressure in preeclamptic women not used magnesium sulfate compared to preeclamptic women used magnesium, (p value=0.000). This result was in agreement with another study⁽²²⁾ which finding confirmed that, Systolic and diastolic blood pressures were significantly decreased during MgSO₄ treatment in preeclamptic patients (p < 0.0001).

Serum magnesium was significantly increased in preeclamptic women used magnesium sulfate as supplement compared to the levels in preeclamptic women not used supplement (p, value =0.000). The results were in agreement with another studies carried by Handwerker,⁽²¹⁾ showed there is over a 100% increase in venous serum levels of ionized Mg during intravenous MgSO₄ therapy of preeclamptic patients.

Conclusion: According to the results of this study it is concluded that the serum levels of calcium, magnesium and potassium are significantly decreased, while the level of sodium is significantly increased in preeclamptic women compared to control group. Magnesium sulfate supplement increase the level of serum magnesium in preeclamptic women.

References:-

1. Ckh Y., parra M., Palma Das R., Nicolaidis KH. Randomized controlled trial using low-dose aspirin in the prevention of pre-eclampsia in women with abnormal uterine Doppler at 23 weeks gestation. *Ultrasound in Obstetrics & Gynecology* 2003, 22:233-239.
2. Khan KS., Wojdyla D., Say L., Gulmezoglu AM., Van Look PF. WHO analysis of causes of maternal death: a systematic review. *Lancet* 2006, 367(9516):1066-1074.
3. Abalos E., Duley L., Steyn DW., Henderson-Smart DJ: Antihypertensive drug therapy for mild to moderate hypertension during pregnancy. *Cochrane Database* 2007, Syst Rev
4. Italian Study of Aspirin in Pregnancy: Low-dose aspirin in prevention and treatment of intrauterine growth retardation and pregnancy-induced hypertension. *Lancet* 1993, 341(8842):396-400.
5. Shaughnessy K.M., Karet F.E. Salt handling and hypertension. *J Clin Invest* 2004; 113: 1075-1081.
6. Iwamoto T., Kita S. Hypertension, Na⁺/Ca²⁺ exchanger, and Na⁺, K⁺-ATPase. *Kidney Int* 2006; 69: 2148-2154.
7. Whelton P.K. Potassium and blood pressure. In: Izzo JL Jr, Black HR, eds. *Hypertension primer*. 3rd ed. Dallas: American Heart Association/Council on High Blood Pressure Research, 2003; 280-282.
8. Dietary reference intakes for water, potassium, sodium, chloride, and sulfate. Washington, DC: National Academies Press, 2005.
9. Belizan J.M., Villar J., Repke J. The relationship between calcium intake and pregnancy induced hypertension: up-to-date evidence. *Am. J. Obstet. Gynecol.* 1988; 158: 898-902.
10. Ambwani S.R., Desai M.K., Girdhar A.O., Shah U.H. Mathur Role of serum electrolytes (Magnesium and Calcium) in Essential Hypertension. *Indian J. Cardiol.* 1999; 1(4): 30-32.

11. Giteman H.J. An improved procedure for the determination of calcium in biochemical specimens. *Anal Biochem* 1967; 18:521-531.
12. Gindler E. M and Heth D. A. Colorimetric determination with bound "Calmagite" of Magnesium in human blood serum. *ClinChem* 1971; 17:662.
13. Sunitha T., Sameera K., Umaramani G. Study of Biochemical changes in Preeclamptic women. *International Journal of Biological & Medical Research*. 2012; 3 (3): 2025-2028.
14. Pralhad K., Kuntal R., Annamma J. Serum Minerals calcium, magnesium, copper and zinc in pregnancy induced hypertension. *Journal of obstetrics and Gynecology of India*.1993;83(1): 33-36.
15. Abdelmarouf H.M., Asma A.D., Yousif H.M, Hamza M.A. Serum calcium levels as a marker of pregnancy induced hypertension. *Sudan Journal of Medical Sciences* 2007; 2(4): 245-248.
16. Pallavi P.C., Pranay A.J., Jasmin H.J. Changes in serum calcium and Magnesium level in preeclampsia vs normal pregnancy. *International J of Biomedical and advance Research*2012; 3(6): 511-513.
17. Selina A., Shelina B., Sultana F. Calcium and Zinc deficiency in preeclamptic women. *Journal of Bangladesh Soc Physiol*. 2011; 6 (2): 94-99.
18. Yussif M.N, Salih M.R, Sami A.Z and Mossa M.M. Estimation of serum zinc, sodium and potassium in normotensive and hypertensive primigravida pregnant women. *Tikrit Medical Journal*. 2009; 15 (1): 13-18.
19. Indumati K., Kodliwadmath M.V and Sheela M.K. The Role of serum Electrolytes in Pregnancy induced hypertension. *Journal of Clinical and Diagnostic Research* 2011; 5(1): 66-69.
20. Sunitha T., Sameera K., Umaramani G. Study of Biochemical changes in Preeclamptic women. *International Journal of Biological & Medical Research*. 2012; 3 (3): 2025-2028.
21. Smith J.M., Lowe R.F., Fullerton J., Currie M.S., Harris L and Kantor E.F. An intergrative review of the side effects related to the use of magnesium sulfate for preeclampsia and eclampsia management. *Pregnancy and Childbirth* 2013, 13:34