

Original article:

Evaluation of levels of serum sodium and potassium in preeclamptic conditions – a case control study

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Abstract

Preeclampsia can lead to derangement of various biochemical parameters in serum, which can cause significant problems of the mother. The present study was undertaken to evaluate the actual alteration of serum electrolytes in preeclampsia. The serum sodium and potassium levels were assayed in 89 subjects; the first group had 46 preeclamptic patients, and the second group consisted of 43 healthy pregnant females as controls. Sodium levels were highly significantly increased and potassium levels were significantly decreased in patients, compared to controls. Early detection of preeclampsia by altered levels of electrolytes may lead to prompt treatment and prevent eclampsia.

Introduction

Preeclampsia, and its sequelae, eclampsia, are important causes of mortality and morbidity in both the mother and fetus(1). Preeclampsia encompasses multiple problems in various tissues, and therefore is a multisystem disorder (2). Hallmarks of preeclampsia include hypertension, proteinuria and edema. Blood pressure more than 140/90 mm Hg, protein excretion more than 300 mg in a day and edema after 20th week of pregnancy are the criteria for preeclampsia(3). In the early phase of preeclampsia it is thought that blood flow to tissues is decreased. This can lead to stimulation of the rennin-angiotensin-aldosterone axis, causing altered levels of serum leading to hypertension(4, 5). As sodium and potassium also are important regulators of hypertension, our study aimed to analyse the pathophysiology of preeclampsia with electrolytes in the background.

Materials and methods

The study was undertaken in a tertiary care hospital of eastern India. 46 preeclamptic patients and 46 healthy age-matched normotensive nonproteinuric pregnant controls were selected. All subjects were primigravida and were randomly selected by a non-biased investigator from the patients of the Obstetrics OPD or IPD. Careful history and examination was performed to include or exclude subjects for the study. Informed consent was taken from all subjects. The institutional ethical committee approved the study. Exclusion criteria were multiple pregnancy, chronic hypertension, renal diseases, concomitant disease, addictions (smoking, alcoholism), history of abortion. 5 ml of venous blood was collected from the patients after overnight fasting. Sodium and potassium levels were estimated by ion selective electrolyte analyzer.

Statistical analysis was done by students unpaired t test using SPSS software.

Results

46 subjects were enrolled in each group, but 3 controls dropped out later during the study. So, the ultimate number of controls came down to 43. Age of patients ranged from 21 to 28, whereas that of controls ranged from 20 to 29. Gestational period ranged from 22 to 36 weeks.

Table 1. Serum sodium and potassium levels (mean + SD) in patients and controls

	Sodium (meq/l)	Potassium (meq/l)
Patients (n=46)	143 + 12.3	4.7 + 0.6
Controls (n=43)	134 + 9.8	3.6 + 0.2

For comparison of serum sodium between 2 groups:

The two-tailed P value equals 0.0003

By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 9.000

95% confidence interval of this difference: From 4.293 to 13.707

Intermediate values used in calculations:

t = 3.8008

df = 87

standard error of difference = 2.368

For comparison of serum potassium between 2 groups:

P value and statistical significance:

The two-tailed P value equals 0.0405

By conventional criteria, this difference is considered to be statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 0.200

95% confidence interval of this difference: From 0.009 to 0.391

Intermediate values used in calculations:

t = 2.0798

df = 87

standard error of difference = 0.096

Serum sodium was highly significantly increased in patients with respect to controls. Serum potassium was significantly decreased in the patient group compared to the control group.

Discussion

Preeclampsia is a pregnancy-specific disorder which is unique, both in its pathophysiology as well as management. On one hand, preeclampsia causes eclampsia, maternal mortality and morbidity; on the other hand preeclampsia leads to fetal problems like growth retardation and prematurity.

Some workers have shown significantly raised serum sodium levels in preeclampsia, but other studies have demonstrated normal sodium levels.[5] In our study, we found that serum sodium was highly significantly increased in patients with respect to controls. In preeclampsia there is reduced intrarenal production of cyclic GMP, endothelin and PGE2 ; this may be important in the the vasospasm, intrarenal thrombosis, sodium retention, and hypertension of preeclampsia(6). The “peripheral arterial vasodilation hypothesis” of sodium and water retention in pregnancy states that with increased endothelial damage, sodium retention and increased sensitivity to angiotensin lead to hypertension, oedema and proteinuria in preeclampsia-eclampsia (7,8).

So, it is not final that increased sodium levels has a definite role in the pathophysiology of preeclampsia, but the findings suggest a possible role, either as a predisposing or risk factor in already predisposed persons. This has to be proved, and there are still areas for further research. A longitudinal study in this regard may be helpful (9).

On the other hand, potassium is thought to play a small role in the development of hypertension. But, a lot of evidence points in the direction that potassium deficit has an important role in hypertension and its problems (10,11). In a clinical study, a diet low in potassium (10 to 16 mmol per day) coupled with the participants' usual sodium intake (120 to 200 mmol per day) caused sodium retention and an elevation of blood pressure; on average, systolic pressure increased by 6 mm Hg and diastolic pressure by 4 mm Hg in normotensive subjects, and systolic pressure increased by 7 mm Hg and diastolic pressure by 6 mm Hg in hypertensive subjects (12).

In normal pregnancy hypokalemia may be due to increased aldosterone and other mineralocorticoid levels in plasma (13). Inadequate conservation of potassium by kidney and alimentary canal lead to potassium deficit; fecal potassium losses can be more than urinary losses (14). Chronic potassium loading is a potent stimulus to aldosterone production in a number of mammals (15). In arterioles, the sodium potassium balance is crucial to maintain normal blood pressure. So, if there are problems with this mechanism, it can lead to hypertension. The extrusion of Na and uptake of K appear to be mediated by a system having the properties of a Na,K-dependent adenosine triphosphatase(16). Varying sodium and potassium levels have been found by various workers(17-20). In our study, we found that serum potassium was significantly decreased in the patient group compared to the control group.

Conclusion:

Thus, we conclude that electrolyte levels in pregnancy might be important early indicators of preeclampsia, and this might aid early detection and treatment.

References

1. Pregnancy-related mortality from preeclampsia and eclampsia, PMacKay A, JBerg C, KAttrash H. *Obstetrics & Gynecology*. Vol 97, Issue 4,2001, pp 533-538
2. Interleukins in preeclampsia. Olusi SO, Diejomaoh M, Omu A, Abdulaziz A, Prabha, K, George S *Annals of Saudi Medicine* 2000, 20(1):4-7
3. Genetics of hypertension in pregnancy: possible single gene control of pre-eclampsia and eclampsia in the descendants of eclamptic women Chesley LC, Cooper DW. *BJOG* Vol 93, Issue9 1986 pp 898-908
4. Longitudinal study of the renin-angiotensin-aldosterone system in hypertensive pregnant women: Deviations related to the development of superimposed preeclampsia August P, Lenz T, et al. *AJOG* 1990 Vol 163, Issue 5, part 1, pp 1612–1621
5. Maternal ethnicity, paternal ethnicity, and parental ethnic discordance: Predictors of preeclampsia. Caughey AB, Stotland NE, Washington AE, Escobar GJ. *Obstet Gynecol* 2005;106:156-61.
6. Urinary Cyclic GMP, Endothelin, and Prostaglandin E2 in Normal Pregnancy and Preeclampsia, B. A. Clark¹, J. Ludmir² et al *Amer J Perinatol* 1997; 14(9): 559-562
7. Peripheral arterial vasodilation hypothesis: A proposal for the initiation of renal sodium and water retention in cirrhosis Schrier RW, Arroyo V, Bernardi M, et al *Hepatology* Vol 8, Issue5 1988 pp 1151-1157

8. Vascular mechanisms of increased arterial pressure in preeclampsia: lessons from animal models Khalil RA, Granger JP, *Am Jr Physiol* , Vol 283 Issue 1 2002 pp R29-R45
9. Serum sodium, potassium, calcium and magnesium in women with pregnancy induced hypertension and preeclampsia in Oredo local Government, Benin Metropolis: A pilot study. Adewolu OF. *Afr J Med Health Sci* 2013;12:1-5.
10. Sodium and Potassium in the Pathogenesis of Hypertension. Horacio J. Adrogué, Nicolaos E. Madias, *N Engl J Med* 2007; 356:1966-1978
11. Influence of dietary potassium and sodium/potassium molar ratios on the development of salt hypertension. Dahl LK, Leitel G, Heine M. *J Exp Med.* 1972; 136(2): 318–330.
12. Potassium depletion exacerbates essential hypertension. Krishna GG, Kapoor SC. *Ann Intern Med* 1991; 115: 77-83.
13. Vascular Na⁺/Ca²⁺ exchanger: implications for the pathogenesis and therapy of saltdependent hypertension. Iwamoto T. *Am J Physiol Regul Integr Comp Physiol* 2006; 290: 536-545.
14. Estimation of serum zinc, sodium and potassium in normotensive and hypertensive primigravida pregnant women. Yussif MN, Salih MR, Sami AZ, Mossa MM. *Tikrit Med J.* 2009; 15, 1: 13-18.
15. Role of potassium in the control of aldosterone secretion in the rat. Boyd, J. E., W. P. Palmore, P. J. Mulrow. *Endocrinology.* 1971. 88:556.
16. Vascular smooth muscle. I. Normal structure, pathology, biochemistry, and biophysics. Somlyo, A. P., Somlyo AV. *Pharmacol. Rev.* 1968. 20:197.
17. Low potassium level during the first half of pregnancy is associated with lower risk for the development of gestational diabetes mellitus and severe pre-eclampsia Wolak T, Sergienko R, Wiznitzer A. *Jr Maternal-Fetal Neonatal Med* Vol 23, 2010 Issue 9
18. Pharmacokinetics of ionized versus total magnesium in subjects with preterm labor and preeclampsia Taber EB, Tan L *AJOG* 2002 Vol 186, Issue 5, pp 1017–1021
19. Fetal ionized magnesium levels parallel maternal levels during magnesium sulfate therapy for preeclampsia BAMason, Standley CA, Whitty JE, Cotton DB, *AJOG* 1996 Vol 175, Issue 1, pp 213–217
20. Sodium excretion in normal and hypertensive pregnancy: A prospective study Brown MA, Gallery EDM, Ross MR, et al *N AJOG* Vol 159, Issue 2, 1988, pp 297-307