Original Article

Spectrum of Electrolytes in Pre-eclampsia; A Case Controlled Study

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Abstract

Objective: To evaluate association of various electrolyte abnormalities with preeclampsia.

Methodology: This was a case control study carried out at CMH Kharian from 1st January till 1st Oct 2020 in which the study population was divided in three groups. Group I- Preeclamptic women, Group II- Normotensive Pregnant women and Group-III, Normal healthy non pregnant controls. Serum magnesium, sodium and potassium were compared among the groups. Participants' ages, parity, weight, and height were recorded on a data collection form following informed consent. Blood pressure readings were taken manually during the first and third trimesters of pregnancy using a sphygmomanometer (Mercury siu China) and a stethoscope. The measurements were taken on the left arm of patients who were seated. At least two measurements were taken and averaged for each patient at a 15-minute interval. One-way ANOVA statistics were applied to find the significance of variations in three groups.

Results: Mean serum sodium was 139±4.429) in preeclampsia group, significantly higher than Normotensive pregnant females 131.65 ± 4.429) and non-pregnant normotensive patients 132 mEq/L (± 3. 654). On the contrary, Serum Potassium was significantly low in the Preeclampsia group 3.6±0.54 when compared to other groups. Similarly low mean concentration of Magnesium 0.918mmol/l (± 0.193) were observed in Preeclampsia group.

Conclusion: The study shows low levels of serum calcium, magnesium, potassium, and increased level of sodium in Preeclampsia in Pakistani patients.

Keywords: Calcium, Magnesium, Sodium, Potassium, Preeclampsia.

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Introduction

Preeclampsia is long known to cause many deaths and severe morbidities during pregnancy. The enormous challenges for patients and the significant drain on health resources have motivated obstetricians to devise a method for early diagnosis and a flawless management plan. A lot of headway has been made in the diagnosis and management of this serious pregnancy related pathology. However, we are still like a child sitting at the seashore yearning to explore the uncharted sea. The overall uncertainty in pathophysiology is the main reason that, despite the latest medical investigations and state of the art intervention technologies, many females end up in complicated pregnancies. Numerous protocols are being adopted to reduce the associated health burden, but a lot is yet to be done.[1]

Many newer approaches based on pathophysiological models are being developed. Research is being carried out at a genetic level also, and it is believed that a full understanding of the disease will be possible in the years to come.[2] However, converting these advancements into clinically useful diagnostic utility is a long-term goal.

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Several authors have attempted to capitalize on well-known disease behaviours associated with hypertensive disorders of pregnancy in order to aid in early diagnosis and prediction of outcome. Not only is this approach straightforward, but it is also likely to result in clinically useful utility.[1]

It goes without saying that pregnancy-related hypertension is associated with a variety of electrolyte abnormalities.[3–5] Electrolyte fluctuations can be used to diagnose preeclampsia. However, the results are conflicting as various authors have reported inconsistent electrolyte numbers in hypertensive disorders of pregnancy. This has resulted inability to devise a reliable criterion to diagnose Preeclampsia.

While there is little disagreement that low serum magnesium is associated with hypertensive disorders of pregnancy, the literature on concentrations of serum sodium, potassium, and other electrolytes is contentious. [6–8] Overall, agreement is required to make clinical decision-making simple and beneficial to the patient. To attain this goal, more data is required, and therefore, we chose this study to find any association of various factors with hypertensive disorders of pregnancy, with special emphasis on serum magnesium, sodium, and potassium. This data can help in predicting the deadly complication of pregnancy at an earlier stage and can contribute to world literature especially from underdeveloped country like Pakistan. It will help clinician in making diagnosis of Preeclampsia more confidently as our findings will help them in this regard.

This study will be a starting point for further research projects as electrolytes are usually routinely performed and little attention is paid to their interpretation and diagnostic significance. Therefore, our study will highlight the need for clinicians to take a deeper look. It can go a long way in enabling decision-making and formulating management plans. Most of the previous literature has emphasized on the role of magnesium in diagnosis and management of hypertensive disorders of pregnancy. Our approach focuses on critically important role played by sodium and potassium, in addition to serum magnesium, in the diagnosis and management of hypertensive disorders of pregnancy. Therefore, our study will empower clinicians to take a clearer view of the situation by taking into consideration serum sodium and potassium concentration in addition to serum magnesium. This might be a better approach and provide a superior opportunity to clinicians for better decision-making process.

Methodology

This was a case control study, which was conducted in the Department of Nephrology in collaboration with Department of Obstetrics and Gynaecology at Combined Military Hospital Kharian from 1st January till 1st Oct 2020.

Prior approval of the study was taken from the Institutional Ethical Committee. A total of 120 study subjects, aged 18 to 35 years old and attending the Obstetrics and Gynaecology Department's labour room/outpatient, were enrolled and divided into three groups of forty each. Group – I Pregnant women who were normotensive, Group II - Preeclamptic women of same gestational age and Group III Normal, healthy, non pregnant controls. A total of 40 women were included in each group. Nonprobability convenience sampling was done.

Inclusion criteria: clinically diagnosed preeclamptic women with gestational age of ≥20 weeks normal pregnant women in the same gestational age and normal healthy non pregnant women in the same age group were enrolled.

Exclusion criteria: Women having history of chronic hypertension, hypertensive disorders of pregnancy, renal diseases, liver diseases, prior cardiovascular disease, severe anaemia, diabetes, systemic or endocrine disorders, or women on any regular medications, smoking, alcoholism & other pre-existing medical conditions were excluded from the study.

Participants' ages, parity, weight, and height were recorded on a data collection form following informed consent. Blood pressure readings were taken manually during the first and third trimesters of pregnancy using a sphygmomanometer (Mercury siu China) and a stethoscope. The measurements were taken on the left arm of patients who were seated. At least two measurements were taken and averaged for each patient at a 15-minute interval.

Procedure used for blood collection: 5ml of blood was drawn from the cubital veins using a sterile 19G hypodermic needle fixed on a 10 ml syringe after cleansing the site with methylated spirit. No tourniquets were applied to avoid hemolysis leading to erratic electrolyte values. Aseptic techniques were strictly adhered to during all stages of sampling and carriage to

laboratory. The blood sample was transferred into a plain test tube, sent to the laboratory, and then spun at a speed of 4,000 rpm for 10 minutes to separate serum from cells. Serum was analyzed for electrolytes using Ericson Photometer (Model 410by Sherwood Scientific Ltd, UK) and values recorded on data collection forms.

Data was entered in SPSS version 20. One way ANOVA statistics were applied to find the significant difference in electrolyte concentration between the three groups. Post hoc analysis was done by applying Games-Howell test. The results were expressed as Mean ± SD. P< 0.05 was considered as statistically significant.

Results

Mean body mass Index was 29 in the Normotensive group, which was slightly lower than Preeclampsia group 31. BMI of Non-Pregnant Healthy group was 25.

Significantly High systolic blood pressure was noted in Preeclampsia group 172mmHg compared to other two groups where mean Systolic Blood pressure was 119mmHG and 122 mmHg in Normotensive group and non-pregnant group respectively. Similar trend was noted in Diastolic Blood pressure. Mean Diastolic Bp was 103 mmHg in preeclampsia group in comparison to 77 mmHg and 81 mmHg in 1st and 3rd group respectively.

Mean age in group 1 was 28.23 ± 4.88), It did not differ significantly from Preeclampsia group 27.8 years (±4.17) and 26.25 years (±3.760) in healthy non pregnant females). In our study Mean serum sodium was 139 (± 4.429) in preeclampsia group which was significantly higher than Normotensive pregnant 131.65 (+ 4.429) and non-pregnant normotensive patients 132 mEq/L (±3. 654). On the contrary, Serum Potassium was significantly low in the Preeclampsia group 3.6 (± 0. 54) when compared to other groups. Serum Potassium was 4 mEq/L and 4.2 mEq/L in group 1 and group 3 respectively. Despite this serum Potassium was non significantly different between pre-eclampsia and normal healthy non pregnant group with P value of 0.396.

Serum Magnesium was significantly lower in Pre-eclampsia group with mean value of 0.9 mmol/L (± 0.283) as compared to 1.9 and 2.1 in group 1 and 3 respectively. Overall low serum Potassium and Magnesium in addition to higher serum Sodium concentrations were observed in Pre-eclampsia group. (Table III)

Discussion

Preeclampsia is a multifactorial and multiorgan dysfunction for which no single component is strictly necessary or sufficient. Historically, this complex pathology has been associated with a variety of electrolyte abnormalities. Thus, electrolyte determination in preeclampsia is a useful index for the study of physiological and pathological changes that occur during pregnancy.[9] Our study tried to establish the association of electrolytes variation with Hypertensive disorders of pregnancy in Pakistani population. If proven this association can probably help in diagnosis and even prevention of Hypertensive disorders in pregnancy. Dietary habits are different in various communities, so results of various populations may not be applicable to Pakistani community.

Our study was focused mainly on Punjabi population living in District Jhelum, Gujrat and Mandi Baha Uddin. This area has been reported to have very high prevalence of hypertension and pregnancy related AKI.[10]

Table I: Comparison of BMI and Blood pressure among study groups (n=120)

Study groups		Age	Parity	Body Mass Index	Systolic BP (mm/Hg)	Diastolic BP (mm/Hg)
Normotensive group (pregnant)	Mean+SD	28.22+4.88	3.03+2.05	28.68+2.06	118.90+18.72	76.53+6.37
	Minimum	20	1	24	11	65
	Maximum	41	8	32	135	90
Eclampsia Group	Mean+SD	27.85+4.17	3.25+2.05	31.10+2.02	171.98+11.88	102.90+7.66
	Minimum	21	1	27	150	90
	Maximum	38	8	34	200	115
Non pregnant Healthy group	Mean+SD	26.25+3.76	2.95+1.70	25.23+2.77	121.57+10.71	81.05+4.87
	Minimum	19	1	22	104	70
	Maximum	31	6	35	138	88
Total	Mean+SD	27.44+4.34	3.08+1.85	28.33+3.33	137.48+28.28	86.83+13.19
	Minimum	19	1	22	11	65
	Maximum	41	8	35	200	115

Table II: Comparison of electrolytes and uric acid among study groups (n=120)

Electrolytes	Study groups	Mean±SD	F-value	p-value
Serum Sodium (mEq/L)	Group I	131.65±4.429		
	Group II	138.85±3.446	45.783	0.0001
	Group III	131.72±3.651		
Serum Potassium (mmol/L)	Group I	4.020±.5417		
	Group II	3.603±.6060	12.678	0.0001
	Group III	4.152±.3419		
Serum Chloride	Group I	96.88±16.185		
	Group II	99.10±4.629	1.956	0.146
	Group III	101.25±3.095		
Serum Uric Acid (mg/dl)	Group I	3.402±1.0329		
	Group II	6.768±1.8858	60.656	0.0001
	Group III	4.698±1.0375		
Serum Magnesium	Group I	1.853±.2837		
	Group II	.918±.1973	212.445	0.0001
	Group III	2.080±.3082		

Group I = Normotensive group (pregnant), Group II = Pre-eclampsia Group, Group III= Non pregnant Healthy group

Table III : Multiple Comparisons Post Hoc analysis (Games-Howell)

Electrolytes	Study groups	Mean±SD		p-value
Serum Sodium (mEq/L)	Group I VS Group II	131.65±4.429	138.85±3.446	0.0001
	Group I VS Group III	131.65±4.429	131.72±3.651	0.996
	Group II VS Group III	138.85±3.446	131.72±3.651	0.001
Serum Potassium (mmol/L)	Group I VS Group II	4.020±.5417	3.603±.6060	0.005
	Group I VS Group III	4.020±.5417	4.152±.341	0.396
	Group II VS Group III	3.603±.6060	4.152±.341	0.0001
Serum Chloride	Group I VS Group II	96.88±16.185	99.10±4.62	0.575
	Group I VS Group III	96.88±16.185	101.25±3.09	0.122
	Group II VS Group III	99.10±4.629	101.25±3.09	0.595
Serum Uric Acid (mg/dl)	Group I VS Group II	3.402±1.0329	6.768±1.885	0.001
	Group I VS Group III	3.402±1.032	4.698±1.037	0.001
	Group II VS Group III	6.768±1.885	4.698±1.037	0.001
Serum Magnesium	Group I VS Group II	1.853±.283	0.918±.197	0.0001
	Group I VS Group III	1.853±.283	2.080±.308	0.003
	Group II VS Group III	0.918±.197	2.080±.308	0.0001

Mean age of our study population was 27 years, which was almost similar in all groups. However, our inclusion criteria may have contributed to it as we selected population between 18 to 35 years. Similarly, mean parity was around 3 in all three groups. Our results regarding demographic data were in keeping with many of the international studies as no statistically significant divergence was noted between maternal age and parity of Normotensive and preeclampsia group. Similar outcomes were reported by Ganesh, Unnikrishnan, Nagaraj, & Jayaram, 2010.[11]

Though the literature on serum sodium levels in preeclamptic patients is conflicting, some studies found no significant difference,[12,13,14] while others found a significant increase in serum Sodium in pre-preeclampsia.[15] Our findings were similar with the pre-eclampsia group having a mean sodium concentration of 139 mEq/l (4.42)[16], which was significantly higher than the normotensive group (132 mEq/l (4.4), P value 0.05).

Mean Potassium level in our study was 3.6 mmol/L (± 0.606) in Normotensive group compared to Pre-Preeclampsia group 4.02 mmol/L (+0.541). There was

significant difference in serum Potassium concentration with p value (<0.05). Similar findings were recorded by Owsu et al.[17] Our findings were in agreement with major bulk of world literature which also reported lower Serum Potassium levels in Pre- Preeclampsia patients.[18–24]

Hypokalemia in preeclampsia may be secondary to abnormality in the transport of sodium and potassium across the vascular smooth muscle, which is normally responsible for the maintenance of blood pressure.[14] In short, Potassium levels were significantly lower in Hypertensive disorders of pregnancy.

Magnesium in the serum has been shown to increase prostacyclin release from blood vessel endothelial cells, which acts as an effective vasodilator. Serum magnesium levels were also significantly decreased in preeclamptic women. As with calcium, it is believed that decreased magnesium levels enhance the contractile response of vascular smooth muscle to vasopressors.

An increase in renal clearance during pregnancy may contribute to the decline in their concentration in preeclampsia. The kidney is the main regulators in the body for serum magnesium levels and blood pressure. [25]

In addition, magnesium drops increase the vasoconstrictor effect of angiotensin II. Magnesium also has a substantial beneficial effect in preeclampsia for the prevention as well as treatment of convulsions. Our study confirmed that the findings of global literature are also valid in the Pakistani population. However, the mean concentration of individual electrolytes are different in our study, but overall trends are analogous. This difference in concentration may be the effect of different dietary habits in the Pakistani community. Mean Serum Magnesium concentration in our Normotensive pregnant population was 1.85mmol/l (±0.283). This figure was significantly low in Preeclampsia group 0.918mmol/l (±0.193). Normal healthy non-pregnant females had mean Serum Magnesium level of 2mmol/l (± 0.308) which was higher than other two groups. It is believed that pregnancy is associated with increased renal clearance during pregnancy. During Hypertensive, disorders of pregnancy this phenomenon may be exaggerated leading to markedly low serum magnesium levels.

Conclusion

In the Pakistani population, hypomagnesemia, hypokalaemia, and hypernatremia are all associated with preeclampsia and may play a significant causative role. Adjuvant calcium, magnesium, and potassium supplementation combined with sodium restriction may help prevent preeclampsia from progressing further.

Limitations of The Study: The Dietary pattern of the study groups related to consumption of, magnesium, sodium, potassium in their diet was not studied which may have significant role in the disease pathophysiology. This may be starting point for further research projects.

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