

STUDY OF SODIUM AND POTASSIUM IMBALANCE IN NEWLY DIAGNOSED HYPERTENSION

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ABSTRACT**BACKGROUND**

Hypertension is one of the leading causes of death and disability among adults all over the world. It remains the major risk factor for coronary, cerebral and peripheral vascular disease. Essential hypertension comprises more than 90% of hypertension. Hypertension is an emerging health problem in India. When majority of people come to know that they have hypertension they have already advanced into a stage with target organ damage– a fatal stroke or myocardial infarction or irreversible renal failure. Unfortunately, even in developed countries like United States, 50 million people have hypertension.

Aim of the study- To study serum sodium and potassium levels and correlate them with the blood pressure in newly detected hypertension.

MATERIALS AND METHODS

This was a cross sectional study conducted in the department of General Medicine at S.S. Medical College Rewa M.P. over a period of one year. Both inpatients and outpatients were included in the study.

RESULTS

In our study, out of 250 patients, 133 were in stage 1 hypertension (53.2%) and 102 patients were in stage 2 hypertension (40.8%). Very small proportions (6%) were having isolated systolic hypertension. Serum sodium was higher in both stage 1 & 2 hypertension and serum potassium was lower in both stage-1 & -2 hypertension.

CONCLUSION

Serum sodium was significantly higher among newly diagnosed hypertensives and also correlated positively with levels of blood pressure. Serum potassium was significantly less among newly diagnosed hypertensives and it correlated negatively with levels of blood pressure.

KEY WORDS

Newly Diagnosed Hypertension, Serum Sodium, Serum Potassium.

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BACKGROUND

Hypertension^[1] is one of the most common disease afflicting humans throughout the world. Because of the associated morbidity and mortality and the cost to society, hypertension is an important public health challenge. Over the past several decades, extensive research, widespread patient education, and a concerted effort on the part of health care professionals have led to decreased mortality and morbidity rates from the multiple organ damage, arising from years of untreated hypertension. Hypertension is the most important modifiable risk factor for coronary heart disease, stroke, congestive heart failure, end-stage renal disease, and peripheral vascular disease. Therefore, health care professionals must not only identify and treat patients with hypertension but also promote a healthy lifestyle and preventive strategies to decrease the prevalence of hypertension in the general

population. The diagnosis and treatment of hypertension^[2] in the young which constitutes one of the major health challenges today because of the high percentage of potentially curable chance if the cause could be found. Indeed, intensive study and investigations are required to unravel the underlying cause.

Hypertension is an emerging health problem in India. When majority of people come to know that they have hypertension they have already advanced into a stage with target organ damage a fatal stroke or myocardial infarction or irreversible renal failure.^[3] Our distant ancestors consumed a low-sodium, high-potassium diet.^[4] and accordingly your kidneys are adapted to conserve sodium and excrete potassium.^[5]

In a country like India, people will have a diet rich in sodium and poor in potassium. We have known for over 2000 years that an acute high dietary sodium intake in the form of a salty^[6] meal, results in a temporary increase in blood pressure and is associated with several other important diseases.^[7] In developed countries, contemporary diets are high in sodium, primarily resulting from the salt added to manufactured foods and low in good sources of potassium such as vegetables and fruit.

Many studies have shown that a positive correlation exists between serum sodium and blood pressure and a negative correlation exists between serum potassium and

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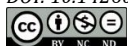
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blood pressure. They have shown that a decreased intake of sodium and increased potassium intake or both together may be effective in prevention or even treatment of hypertension. Independent reports on serum sodium and potassium among Indian hypertensive population were lacking and hence the present study was conducted.

MATERIALS AND METHODS

This was a cross sectional study conducted in the department of General Medicine at S.S. Medical College Rewa M.P. over a period of one year. Both inpatients and outpatients were taken in to study.

Sample Size

A total of approximately 250 subjects who fulfil inclusion and exclusion criteria were taken for this study after obtaining a written informed consent.

Data Collection Method

A detailed history was taken and recorded. The patients were thereafter subjected to complete clinical examination including ocular fundus examination by expert ophthalmologist for assessment of retinopathy and laboratory investigations. Data collected were analyzed by appropriate statistical methods.

Inclusion Criteria

- Patients with newly diagnosed hypertension.
- Patients above 18 years of age.
- Both males and female.
- BP ≥ 140/90 mm of Hg (According to JNC 8).

Exclusion Criteria

- Patients with known case of heart failure, Chronic Kidney Diseases, any underlying malignancy.
- SIADH, thyroid disease, Pheochromocytoma.
- Pregnancy.
- Patients with drug induced sodium and potassium imbalance.

Statistical Analysis

Statistical analyses were carried out using computer based statistical analysis programme SPSS (Statistical programme for social sciences) version 22.0. The Chi-square and Fischer exact test were used wherever comparison were needed between two groups or between two categories in the same group. A p value <0.05 was considered significant.

RESULTS

SL. No.	BP	Total no. of Cases (n= 250)	(%)
1	Stage 1 hypertension	133	53.2
2	Stage 2 hypertension	102	40.8
3	Isolated systolic hypertension	15	6
Total		250	100.0
Distribution of Cases according to Blood Pressure on Admission			

In this study a very small proportion of patients (6%) had isolated systolic hypertension. Rest of the patients had both

systolic and diastolic BP raised.

Haemoglobin (gm%)	S. Sodium
TLC (cells/cumm)	S. Potassium
Neutrophils (%)	X-ray Chest
Lymphocytes (%)	ECG
Eosinophils (%)	USG abdomen
Monocytes (%)	SGOT (IU/L)
Basophils (%)	S. Albumin (gm%)
Platelets (cells/cumm)	Random Blood Sugar
ESR (mm/FHR)	Urine -R/M
B. urea (mg%)	S. Creatinine (mg%)
TSH	S. Uric Acid
SGOT (IU/L)	SGPT (IU/L)
Fundus examination	
Investigation Details: Investigation Chart	

Sodium Level	Stage 1 Hypertension		Stage 2 Hypertension		Isolated Systolic Hypertension		Total		
	No	%	No	%	No	%	No	%	
<135	25	18.79	6	5.88	0	-	31	12.4	
135 to 140	40	30.07	30	29.42	3	20.0	73	29.2	
140 to 145	50	48.57	60	58.82	6	40.0	116	46.4	
>145	18	13.57	6	5.88	6	40.0	30	12.0	
Total	133	100.0	102	100.0	15	100.0	250	100.0	
$\chi^2 = 29.20$				$p < 0.0001$					
Association between Sodium and Systolic Hypertension									

Distribution of systolic hypertension according to sodium levels was found to be positively correlated and statistically significant (p<0.0001) Maximum no of hypertensive patients lie in the range of sodium level above 140 (58.4%) and minimum number of hypertensive patients lie below sodium level 135 (12.4%). In isolated systolic hypertension maximum no lie where sodium levels are above 140 (80%). In stage 1 hypertension maximum no of hypertensive patients have a sodium level between 140-145 (48.57%) In stage 1 minimum number of patients were in less than 135(18.7%). In stage 2 maximum number of hypertensive patients were in above 140(64%). In stage 2 minimum no of patients were in the sodium range less than 135(5.8%).

Sodium Level	Stage 1 Hypertension	%	Stage 2 Hypertension	%	Total	%
<135	16	12.03	9	8.8	25	10.6
135 to 140	35	26.3	45	44.11	80	34.04
140 to 145	69	51.8	35	34.3	104	44.25
>145	13	9.77	13	12.7	26	11.06
Total	133	100.0	102	100.0	235	100.0
$\chi^2 = 10.41$			$p = 0.0153 (S)$			
Association between Sodium and Diastolic Hypertension						

Distribution of diastolic hypertension according to sodium level was found to be positively correlated and statistically significant (P=0.0153) Maximum no of patients lie in this sodium level of above 140 (52.0%) and minimum number of patients lies in the level of <135 (10%). In stage I hypertension 60% of patients lies in the sodium level of above 140, minimum number of patients in stage I hypertension in the sodium level of <135 (12.0%). In Stage II hypertension maximum number of patients lies in the sodium

level of 140 (47.0%) and minimum number of patients in stage II hypertension in the sodium level of <135 (8.8%).

Potassium Level	Stage 1 Hypertension		Stage 2 Hypertension		Isolated Systolic Hypertension		Total		
	No	%	No	%	No	%	No	%	
<3.5	58	43.6	32	31.3	8	53.3	98	39.2	
3.5-4.5	35	26.3	50	49.01	4	26.6	89	35.6	
4.5-5.5	22	16.54	15	14.7	2	13.33	39	15.6	
>5.5	18	13.53	5	4.9	1	6.6	24	9.6	
Total	133	100.0	102	100.0	15	100.0	250	100.0	
$\chi^2 = 16.53$				$p = 0.0112$					
Association between Potassium and Systolic Hypertension									

Distribution of systolic hypertension according to potassium levels was found to be negatively correlated and statistically significant ($p=0.0112$). The maximum number of patients had potassium levels of <3.5 (39.2%) and minimum number of patients had potassium level of more than 5.5 (9.6%). In stage 1 Hypertension, maximum number of hypertensive patients had <3.5 potassium levels and in stage 2 Hypertension maximum patients had levels between 3.5 to 4.5. In case of isolated hypertension maximum patients had potassium levels of < 3.5. (53.3%). Minimum number of patients had potassium levels of more than > 5.5 (9.6%). In case of stage 1 Hypertension minimum patients had potassium levels of > 5.5(13.53%) In case of stage 2 Hypertension minimum no patients had potassium levels of > 5.5 (4.9%). Minimum number of patients in isolated Hypertension had potassium levels of > 5.5 (6.6%).

Potassium level	Stage 1 hypertension	%	Stage 2 hypertension	%	Total	%
<3.5	56	42.1	29	28.4	85	36.17
3.5-4.5	32	24.06	53	51.9	85	36.17
4.5-5.5	24	18.04	13	12.74	37	15.74
>5.5	21	15.78	7	6.8	28	11.91
Total	133	100.0	102	100.0	235	100
$\chi^2 = 15.00$				$p = 0.0018$		
Association between Potassium and Diastolic Hypertension						

Distribution of diastolic hypertension according to potassium levels was negatively correlated & was found to be statistically significant ($p=0.0018$). The maximum number of patients lie in the potassium level <3.5(34%) and minimum number of patients lie in the potassium level of more than 5.5 In stage 1 Hypertension maximum number of patients lie in potassium level <3.5 (42.1%). In stage 2 Hypertension maximum patients lie in potassium level 3.5 – 4.5 (51.9%). Minimum number of patients lie in potassium level >5.5 (11.2%). Minimum number of patients in stage 1 hypertension lie in potassium level >5.5 (15.78%). Minimum number of patients in stage 2 hypertension lie in potassium level > 5.5 (6.8%).

DISCUSSION

Hypertension is one of the leading causes of death and disability among adults all over the world. Hypertension the most common form of cardiovascular disease is present in nearly 25% of adults and increases in prevalence with age. It remains the major risk factor for coronary, cerebral and

peripheral vascular disease.^[8] Essential hypertension comprises more than 90% of hypertension. Patients were studied on the basis of clinical parameters and simple biochemical investigations. Serum sodium and potassium was done for all the patients. In our part of the country, there is excessive intake of dietary salt. But in spite of that not everyone has essential hypertension.^[9] The rarity of hypertension among those consuming large amount of salt may probably be related to chronic adaptation of body system towards renal clearance of sodium. However, this aspect of chronic adaptation of sodium handling by kidneys requires further molecular studies. So in addition to the hereditary predisposition and high sodium intake and lower potassium intake, the renal handling of these cations also play an important role in the pathogenesis of essential hypertension.^[10] Salt intake was more in the tropical countries by and large in order to overcome sodium loss through sweating. In modern days the consumption of salt is more than earlier days in view of various food preparations or a combination of them, as man is tuned more to taste of the food. Combination of food materials requires additional salt. As a result, people consume more than actually required (2 vs. 8-10 g/day/person). Such an amount of salt consumption contributes for the development of hypertension in a genetically susceptible population.^[11]

In the present study serum sodium is positively correlated with levels of blood pressure and it is statistically significant. Most of the patients (>58.4%) were in above 140 sodium level and minimum number of patients were in the range of sodium <135 (12.4%). In stage 1 hypertension maximum number of patients (48.51%) are in range of 140-145 sodium level and minimum number of patients were in less than 135 (18.7%) sodium level. In stage 2 hypertension most of the Patients (58.82%) were in the level of 140-145. In stage 2 minimum number of patients (5.8%) at the level of less than 135. In isolated hypertension 80% of the patients were in above 140 sodium level. (P value<0.0001)

In the present study serum sodium is positively correlated with levels of blood pressure and it is statistically significant. Most of the patients (41.6%) were at the level of sodium 140-145. In stage 1 hypertension 60% were above 145 sodium level. In stage 1 hypertension Minimum number of patients (12.3%) are in less than 135 level. In stage 2 hypertension 45% patients are at level of above 140. In stage 2 hypertension minimum number of patients (8.8%) are at the level of less than 135 (P value=0.0153).

Our study is also supported by Anand Kumar et al. (2017).^[12] According to this study serum sodium was significantly more among hypertensive and also correlated positively with levels of blood pressure. Serum potassium was significantly less among hypertensives and is correlated negatively with blood pressure.

Our study is also supported by Kawasaki et al (1978),^[13] found the effect of very low sodium (10 meq/day) or high (200 meq/day) dietary sodium intake on blood pressure in patients with essential hypertension. They found that half of the patients fed with high dietary sodium intake displayed rise in blood pressure more than 10 percent.^[14]

In present study serum potassium is negatively correlated with levels of blood pressure and it is statistically significant. In the present study most of the patients (39.2%) are at the level of potassium less than 3.5. In stage 1 hypertension most of the patients (70%) were in the level of less than 4.5. In

stage 1 minimum number of patients (13.5%) were in above 5.5 potassium level. In stage 2 hypertension most of the patients (80%) were at level of less than 4.5. Minimum number of patients (4.9%) are at the level of more than 5.5.

In isolated hypertension most of the patients (53.3%) were at level less than 3.5. Minimum number of patients (6.6%) were at the level of more than 5.5 (P value =0.0112)

In present study serum potassium is negatively correlated with levels of blood pressure and it is statistically significant. In most of the patients (36%) were at the level of potassium less than 3.5. Minimum number of patients (11.2%) were at level of more than 5.5 potassium level. In stage 1 hypertension most of the patients (42.1%) were in potassium level less than 3.5 and minimum number of patients (15.78%) were in the potassium level above 5.5. In stage 2 hypertension most of the patients (51.9%) at the potassium level 3.5 to 5.5. Minimum number of patients (6.8%) at the level of more than 5.5 potassium. (P value =0.018)

Our study was supported by Jan et al (2006), Srinagar, Kashmir. In this study serum sodium was higher in hypertensive group and considered to be factor responsible for the causation or perpetuation of blood pressure.^[14]

A study was carried out by Bulpitt et al (1981).^[15] According to them decreasing plasma potassium 1 mmol/L were associated with increase in systolic and diastolic blood pressure by 7/4 mmHg in women and 4/2 mmHg in men respectively.

A study was carried out by Sathvika et al (2017).^[16] According to them serum sodium was more among hypertensives and it is independent of associated risk factors and gender. Serum sodium levels correlated positively with levels of blood pressure. Serum potassium was significantly less among hypertensives and it correlated negatively with blood pressure.^[16]

CONCLUSION

Essential hypertension is the major risk factor for coronary, cerebral and renal vascular diseases. Aetiology for essential hypertension is not known. Many theories have been postulated. The present study attempts to focus the serum sodium and potassium levels among newly diagnosed essential hypertensives who were free from any other illnesses or under any medication and to correlate electrolyte status with the blood pressure. Serum sodium was significantly more among hypertensives and also correlated positively with the level of blood pressure. Serum potassium was significantly less among hypertensives and it correlated negatively with blood pressure. Changing life style have modified the food habits, making people to consume food rich in sodium but low in potassium. As a result, in genetically susceptible population when exposed to high sodium content coupled with low potassium in their diet, hypertension becomes overt.

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