

Serum Sodium and Potassium in Newly Diagnosed Essential Hypertensive Patients.

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ABSTRACT

Background: Hypertension is one of the most common worldwide diseases afflicting humans & 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. **Aim:** To study the levels of sodium and potassium in serum in patients with Essential Hypertension and to correlate it with Blood pressure in case of newly detected Essential Hypertensives. **Methods:** Prospective comparative study in patients with 100 (50 cases +50 controls) patients with essential hypertension. All the patients were subjected to detailed history taking, careful physical examination and biochemical analysis to exclude secondary hypertension. **Results:** The results of the study, between cases and controls were statistically significant. The mean value of serum sodium was 146 ± 2.81 mmol/L in males and 148 ± 4.2 mmol/L in females. The mean and standard deviation of serum potassium among cases was 3.79 ± 0.179 mmols/L while on control groups it was 4.25 ± 0.22 mmol/L. **Conclusion:** The conclusions of the study are serum sodium was significantly more among hypertensives and it was independent of associated risk factors and gender.

Keywords: Primary hypertension, Serum sodium, Serum potassium, BMI

INTRODUCTION

Hypertension affects approximately 25% of the adult population worldwide, and its prevalence is predicted to increase by 60% by 2025, when a total of 1.56 billion people may be affected. It is the major risk factor for cardiovascular disease and is responsible for most deaths worldwide. Primary hypertension, also known as essential or idiopathic hypertension, accounts for as many as 95% of all cases of hypertension. Primary hypertension results from the interplay of internal derangements (primarily in the kidney) and the external environment. Sodium, the main extracellular cation, has long been considered the crucial environmental factor in the disorder. Patients were studied by clinical parameters and simple biochemical investigations. Serum sodium and potassium was done for all the patients.^[1-4]

In our part of the country, there is an excessive intake of dietary salt. But in spite of that, not everyone has essential hypertension. The rarity of hypertension among those consuming a 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.^[5-7]

Salt intake was more in the tropical countries by and large to overcome sodium loss through sweating. In modern days the consumption of salt is more than earlier days gave various food preparations or a combination of them, a man is turned more to taste of the food. Combination of food materials requires additional salt. As a result, people consume more than required (2 vs. 8-10 g/day/person). Such an amount of salt consumption contributes to the development of hypertension in a genetically susceptible population.^[8-11]

Aim

To study the levels of sodium and potassium in serum in patients with Essential Hypertension and to correlate it with Blood pressure in case of newly detected Essential Hypertensives.

MATERIALS AND METHODS

The prospective comparative study was conducted in Department of Medicine in Tirunelveli Medical

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College. 100 patients (50 cases and 50 controls) were included in the study.

Inclusion Criteria

Patients with essential hypertension, age above 30 yrs, both sexes were included. Exclusion Criteria: patient below 30 years, patients with diabetes mellitus, Patients with renal failure / active urinary sediments / significant proteinuria, Pregnant, patients whose BP shows significant disparity between right and left arm or between upper limbs and lower limbs, patients with bruit in renal arteries, patients with peripheral vascular disease, patients admitted with features of malignant hypertension, hypertensive encephalopathy, flash pulmonary edema and other hypertensive emergencies, patients with acute diarrhoeal disease, patients on NSAIDS, antihypertensives, diuretics, oral contraceptives, beta blockers or agonists.

The study group thus identified by the above criteria (inclusion and exclusion criteria) was first instructed about the nature of the study. Willing participants were taken up after getting a written informed consent from them.

All the patients were subjected to detailed history taking, careful physical examination and biochemical analysis to exclude secondary hypertension. Patient's height and weight were measured. The body mass index was calculated using the formula Weight / Height in Meter². Patient's hip and waist circumferences were measured. All the peripheral pulses were checked with special attention to carotid and the femoral to detect evidence for early atherosclerosis. An ocular fundus examination was done to detect hypertensive retinopathy.

Patients were informed to refrain from smoking or drinking tea or coffee for at least thirty minutes before measuring blood pressure. The blood pressure was measured using the following guidelines.

RESULTS

Table 1: The distribution of the cases and controls in relation to age

| Age group | Cases | | Controls | |
|-----------|-------|----|----------|----|
| | No. | % | No. | % |
| 31-40 | 4 | 8 | 4 | 8 |
| 41-50 | 20 | 40 | 24 | 48 |
| 51-60 | 22 | 44 | 18 | 36 |
| 61-70 | 4 | 8 | 18 | 36 |
| Mean | 51.6 | | 50.8 | |
| SD | 6.82 | | 6.59 | |

The total number of subjects included in this study was 100. Among these 100 subjects, 50 were cases (Hypertensive) and 50 were controls (Normotensive). The age of the subjects in the study group ranged from thirty to sixty five years. The mean and standard deviation for the age of the cases and controls were 51.6 ± 6.82 and 50.8 ± 6.59 years

respectively. The study group and the control group did not differ from each other statistically with reference to age.

Majority of the patients in both the study and control group lie between 41 and 60 years. There was no significant difference in the age composition of those with and without hypertension in this study. Almost same age group of patients was selected in both groups. Among the 70 cases studied, there were 38 males and 32 females. Among the 30 controls, there were 20 males and 10 females. The mean age distribution for the males in the case and control groups was 51.4 ± 7.2 years and 52.1 ± 6.7 years respectively. The mean age distribution for the females in the case and control groups was 51.8 ± 6.39 years and 49.4 ± 6.33 years respectively.

Table 2: Gender wise distribution of cases and controls

| Sex | Cases | | Controls | |
|--------|-------|-----|----------|-----|
| | No. | % | No. | % |
| Male | 30 | 60 | 25 | 50 |
| Female | 20 | 40 | 25 | 50 |
| Total | 50 | 100 | 50 | 100 |

62% of the cases were overweight and 10% cases were obese, whereas only 8% of controls were overweight and 2% cases were obese.

Table 3 Distribution of cases and controls with respect to BMI

| BMI | Cases | | Controls | |
|---------------------------|-------|-----|----------|-----|
| | No. | % | No. | % |
| Underweight < 18.5 | 4 | 8 | 1 | 2 |
| Healthy Weight 18.5-24.9 | 10 | 20 | 44 | 88 |
| Over Weight 25 - 29.9 | 31 | 62 | 4 | 8 |
| Obesity 30-39.9 | 5 | 10 | 1 | 2 |
| Extreme Obesity \geq 40 | 0 | 0 | 0 | 0 |
| Total | 50 | 100 | 50 | 100 |

The mean body mass index in the case group is 26.1 ± 3.64 and in the control group is 23 ± 2 . This shows that the difference in Body Mass Index between cases and controls was statistically significant.

Table 4: BMI with respect to stage of hypertension

| BMI | Stage I Hypertension | | Stage II Hypertension | |
|-------------|----------------------|----|-----------------------|----|
| | No. | % | No. | % |
| < 18.5 | 2 | 4 | 1 | 2 |
| 18.5 - 24.9 | 2 | 4 | 10 | 20 |
| 25 - 29.9 | 5 | 10 | 25 | 50 |
| 30 - 39.9 | 1 | 2 | 4 | 8 |

Body mass index was independent of gender and electrolyte status, but it was significantly more in those with Stage II hypertension. The most common presenting symptom among cases is giddiness. Other symptoms were in the order of headache, palpitation, dyspnea, chest pain, easy fatigability.

Table 5: Analysis of Presenting Symptoms

| Symptoms | Male | | Female | |
|--------------------|------|----|--------|----|
| | No. | % | No. | % |
| No symptoms | 1 | 2 | 3 | 6 |
| Headache | 4 | 8 | 2 | 4 |
| Giddiness | 20 | 40 | 13 | 26 |
| Chest Pain | 1 | 2 | 1 | 2 |
| Palpitation | 2 | 4 | 0 | 0 |
| Dyspnea | 1 | 2 | 0 | 0 |
| Easy fatigability | 1 | 2 | 0 | 0 |
| Blurring of vision | 0 | 0 | 1 | 2 |

Analysis of other risk factors like smoking, alcoholism and family history were done among hypertensives.

Table 5: Risk factor analysis

| | Smoking | Alcohol | Both | Positive Family History |
|----------|---------|---------|------|-------------------------|
| Cases | 18 | 10 | 8 | 27 |
| Controls | 11 | 6 | 3 | 20 |

Table 6: Distribution of systolic and diastolic blood pressure

| Blood Pressure | Cases | | Controls | |
|----------------|-------|------|----------|------|
| | Mean | SD | Mean | SD |
| Systolic | 171 | 14.7 | 113 | 5.94 |
| Diastolic | 103 | 7.89 | 72.5 | 4.08 |

The mean systolic blood pressure for the cases was 171 ± 14.7 mm Hg. Similarly the mean diastolic blood pressure for the cases was 103 ± 7.89 mm Hg. Since the systolic and diastolic blood pressure was elevated in cases and it was due to the nature of the disease taken into study, the statistical analysis was not done. Serum sodium in the study population varied from 139 to 153 mmol / L and in the control from 136 to 144 mmol / L. The mean and Standard deviation of serum sodium among cases was 147 ± 3.10 mmol / L while in the control group it was 138 ± 1.8 mmol / L respectively. This table clearly shows that the serum sodium level was significantly more among hypertensive population studied.

Table 7: Serum Sodium levels in cases and controls

| Serum Sodium | Cases | | Controls | | P value |
|--------------|-------|------|----------|-----|---------|
| | Mean | SD | Mean | SD | |
| | 147 | 3.19 | 138 | 1.8 | <0.0001 |

The mean value of serum sodium was 146 ± 2.81 mmol / L in males and 148 ± 4.2 mmol/L in females among cases. The mean value of serum sodium was 138 ± 3.1 mmol/L in males and 138 ± 2.45 mmol/L in females among controls. Serum potassium in the study population varied from 3.3 to 4.5 mmol/L and in the control from 3.8 to 4.6 mmol/L. The mean and standard deviation of serum potassium among cases was 3.79 ± 0.179 mmol/L. While in the control group it was 4.25 ± 0.223 mmol/L respectively. This table clearly shows that the serum Potassium level was significantly lower among the hypertensive population studied.

Table 8: Serum potassium level in cases and controls

| Serum potassium | Cases | | Controls | | P value |
|-----------------|-------|-------|----------|-------|---------|
| | Mean | SD | Mean | SD | |
| | 3.79 | 0.179 | 4.25 | 0.223 | <0.0001 |

The mean value of serum potassium was 3.79 ± 0.182 mmol/L in males and 3.79 ± 0.224 mmol/L in females among cases. The mean value of serum potassium was 4.26 ± 0.231 mmol/L in males and 4.23 ± 0.219 mmol/L in females among controls. Urinary analysis, Blood glucose, blood urea and serum creatinine were well within acceptable limits and did not differ from healthy control. Electrocardiogram revealed left ventricular hypertrophy in about 24 percent of study group, left atrial enlargement in 22% and left anterior hemiblock in 2%. Chest X ray showed cardiomegaly in about 42 percent of cases. Ocular fundus examination revealed hypertensive retinopathy in about 30 percent of the study group.

DISCUSSION

Serum sodium was higher in the hypertensive group than the control group even though both were within the normal range. The mean and standard deviation of serum sodium among cases was 147 ± 3.19 while in the control group it was 138 ± 1.38 respectively. Our study was supported by Jan et al. (2006), Srinagar, Kashmir. In his study, one hundred thirty-five hypertensive patients and the equal number of age and sex-matched healthy controls were taken for the study. Serum sodium in the hypertensive group was 140 ± 2.90 while in the control group it was found to be 138.5 ± 1.12 . Serum sodium was higher in the hypertensive group than the control group and considered to be a factor responsible for the causation or perpetuation of blood pressure.^[12] A study was carried out by Lever et al. of arterial pressure and body content of electrolytes in 91 patients with essential hypertension and 121 normal controls.^[13] Plasma and exchangeable sodium were found to be positively correlated with arterial pressure in the patients and plasma, exchangeable, and total body potassium correlated inversely with arterial pressure in the patients, the correlations being closest in young patients. Three hypotheses were proposed to explain the mechanisms relating electrolytes and arterial pressure in essential hypertension. In the early stages of the disease blood pressure is raised by an abnormal process related more closely to potassium than to sodium. A renal lesion develops later, possibly as a consequence of hypertension. This lesion is characterized by resetting of pressure natriuresis and is manifest by an abnormal relation between body and sodium and arterial pressure and by susceptibility to increased dietary sodium intake. In another study conducted by Nanji et al., it was shown that a positive correlation exists between serum sodium and hypertension.^[14] A

study was conducted among Japanese people by Komiya et al. They studied 3222 normal Japanese subjects (610 in Kashwia City Hospital and 2612 in Shinshu University Hospital), 741 Japanese patients with essential hypertension (256 in Kashwia City Hospital and 485 in Shinshu University Hospital) to determine the possible roles of sodium, renal function, and plasma aldosterone concentration (PAC) on blood pressure elevation. They found that the peak of the serum sodium distribution curve was approximately 2 mmol / L higher in the hypertensive group as compared with that in the control group. The prevalence of higher serum sodium concentration ($>$ or $=$ 147 mmol / L) was also significantly higher in the hypertensive group.^[15] In another study conducted by Bulpitt, two thousand, three hundred and Twenty Eight men and 1496 women between the ages of 35 and 64 years were screened for hypertension and their plasma sodium was positively related to that of blood pressure and an increase in serum sodium of 1 mmol / L was associated with an increase of 1 mm of Hg in both men and women.^[16] In a study carried out at the University of Tokyo, they measure plasma electrolytes in 82 essential hypertensive patients to examine the relation between blood pressure and plasma electrolytes. Significant negative correlation was observed between plasma potassium concentration and 24-h systolic blood pressure ($r = -0.336$) and diastolic blood pressure ($r = -0.298$) in their patients. Plasma potassium concentration inversely correlated also with both daytime and nighttime systolic and diastolic blood pressure. There was no relation between office blood pressure and plasma potassium concentration. These findings indicate that in essential hypertensives plasma potassium concentration is inversely related to ambulatory blood pressure including daytime and nighttime blood pressure and suggest that potassium may be a factor determining the whole day blood pressure in essential hypertension.^[17] To investigate the role of potassium in blood pressure Luft et al., conducted a study among 431 normotensive and 478 hypertensive subjects. They observed an inverse relationship between serum potassium and blood pressure supporting our study.^[18] In our study, the mean BMI among the study group was 26.1 ± 3.64 and among the control group was 23 ± 2 . the 'p' value was 0.0001. This shows that overweight and obesity also plays a role in the development of essential hypertension.

CONCLUSION

Serum sodium was significantly more among hypertensives, and it was independent of associated risk factors and gender. Serum sodium level was also correlated positively with the level of blood pressure. Serum potassium was significantly less among hypertensives, and it correlated negatively with blood pressure. Serum sodium and potassium were

independent of body mass index. Given the significant changes in simple electrolyte levels (sodium and potassium) among the hypertensive population, the community must be motivated to reduce their intake of common salt and encouraged to consume potassium-rich nutrient – diets as a form of primary prevention for essential hypertension.

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