

Significance of Serum Sodium and Disorders on Altering its Concentration in Chronic Renal Failure Patients

Punam Yadav, *Dinkar Malik, Sandeep Kumar

Department of Chemistry, M. S. College, Saharanpur-247001, Uttar Pradesh, India.

ABSTRACT

Sodium is widely distributed in food materials, more in animal sources than plants. Sodium ion concentration is very important in regulation of osmotic pressure of body fluids, preservation of normal irritability of muscles and the permeability of the cells. Most of the sodium is found in the extracellular fluid. Almost all the blood sodium is found in the plasma, there is very little in the red cells. In chronic cases the plasma concentration may be only slightly lower. A negative balance of sodium or potassium may cause renal failure. Changes in sodium concentration largely lead to severe diarrhea, vomiting, diabetes, acute pathological processes involving the brain, diuretics and hyponatraemia, lead to a salt deficiency and hence to low plasma sodium values which may be exaggerated if water losses are replaced without adequate salt therapy. Hyponatraemia results when the water content of the body is increased absolutely and relative to the sodium content so that the osmolality of body fluid falls. The most common pathogenesis of hyponatraemia is mixed salt and water depletion. The present paper includes the study of serum sodium levels of 200 patients (according to age group and sex) with chronic renal failure (CRF) before and after the process of treatment and it has been compared with 50 normal healthy individuals comprising the control group.

Keywords: Body fluids, chronic renal failure, extracellular fluid, hyponatraemia, potentiometric measurement, serum sodium

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*Address for correspondence:

Dr. Dinkar Malik,

Department of Chemistry, M. S. College, Saharanpur-247001, Uttar Pradesh, India.

E-mail: dinkar_malik@rediffmail.com

INTRODUCTION

Sodium is the major components of the cations of the extracellular fluid and exists in the body in association with the anion is chloride, bicarbonate, phosphate and lactate. It is largely associated with chloride and bicarbonate in regulation of acid-base equilibrium. The other important function of sodium is the maintenance of the osmotic pressure of the body fluid thus protecting the body against excessive fluid loss. It also functions in the preservation of normal irritability of muscles and the permeability of the cells. About one third of the total sodium contents of the body are present in the inorganic portion of the skeleton. Most of the sodium is found in the extracellular fluid. Sodium ion concentration is very important in regulation of osmotic pressure of body fluids. The total osmotic pressure is equal to the sum of the osmotic effective-

ness of all the ions present, change in sodium concentration largely affect the osmotic pressure. Loss of sodium may be compensated to a very small extent by an increase in potassium. The loss of sodium from the body, as in Addison's disease and prolonged diatetic ketosis, leads to significant lowering of osmotic pressure of body fluid and therefore loss of water (dehydration). Osmotic pressure will not regain until the loss of sodium and water are replaced. 1.0-3.5 gms of sodium is required daily for adults, Infant needs 0.1-0.5 gms and children 0.3-2.5 gms daily [1]. In temperate region, the sodium chloride intake is less but in tropical countries the intake is more. A person suffering from hypertension should not take more than one gm of sodium [2]. In chronic cases the plasma concentration may be only slightly

lower. Conditions in which extracellular fluid is lost, such as vomiting, diarrhea and intestinal obstruction, lead to a salt deficiency and hence to low plasma sodium values which may be exaggerated if water losses are replaced without adequate salt therapy. There is also a non specific fall in plasma sodium values (to about 130-135 meq/L) which occurs in many chronic diseases, as a terminal phenomenon the fall may be greater. The adults' normal range for serum sodium reported by many scholars is in fairly close agreement which they have reported as 135-155 meq/L [3-5]. It was suggested that two ranges are required, a normal range (137-147 meq/L) to make assertion about alterations in specific disease and a range derived from patients likely to have no manifest disturbances of salt and water metabolism (135-144 meq/L) to detect such disturbances. The mean value for sodium in the serum of normal individuals has been determined to be as 145 meq/L with a S.D. of 2.2 meq/L [6]. In a study of 35 normal Indian subjects (25 males and 10 females in the age group of 17-62 years with an average age of 32.4 and 26.3 years for males and females respectively. Average age of combined sexes being 30.7 years) has reported the range of plasma sodium to be from 136-148 meq/L with a mean value of 142.04 meq/L [7]. The recommendations and observations regarding the treatment of hyponatremia, its characteristics and mortality in patients with chronic kidney disease have been given by many workers [8-12]. The transport of inorganic solutes such as sodium, potassium, magnesium, calcium, and phosphate in body becomes abnormal in chronic renal failure patients [13]. The low concentration of serum sodium, renal function, disorders of body

Observations:

Table I: Showing Distribution of C.R.F. Cases According to Age Group and Sex

Age Groups (Years)	Number of cases		Total
	Males	Females	
10-30	5	2	7(3.5%)
31-50	50	25	75(37.5%)
51-70	63	40	103(51.5%)
71-above	10	5	15(7.5%)
Total	128(64.0%)	72(36.0%)	200(100.0%)

fluid and relationship of serum electrolytes with clinical outcome develops new problems in chronic renal failure patients [14-19]. Chronic kidney disease is known to affect by the disturbance in the concentration of serum urea, serum creatinine, serum electrolytes and serum uric acid [20-22].

EXPERIMENTAL

Materials and methods:

The present study was carried out on 200 adult patients of chronic renal failure attended in the S.V.B.P. hospital attached to L. L. R. M. Medical College, Meerut and also 50 normal healthy individuals with age, sex matched who had no history of renal failure to serve as controls. All the known cases of chronic renal failure were included in this study on the basis of clinical and biochemical criteria. After confirmation of diagnosis on the above parameters, blood samples were drawn from these patients for the estimation of serum electrolyte (Na & K). CIBA-CORNING 644 is a sodium, potassium and chloride ion selective electrode (ISE) analyzer. It is designed for fast and accurate determination of sodium, potassium and chloride ion in undiluted serum, plasma, whole blood and pre diluted urine samples. Minimum sample volume is 65 µl and result is displayed on the alpha numeric in mmol/L (Milimoles per liter). The maximum range of serum sodium is 130-150 mmol/L. Potentiometric measurement of electrolyte is in principle similar to the pH measurement. Each electrolyte requires a specific ion selective membrane, an internal filling solution and a reference electrode, which may be in common with the pH system. In the CIBA-CORNING 644 the sodium ion selective electrode is equipped with a glass membrane selective to sodium ions.

Out of 200 individuals, 128 (64%) controls were male's individuals and rest 72 (36%) were females. All the 200 individuals were between the age group of 10 above 70 years. The maximum number of cases, 103 (51.5%), were observed in the age group of 51-70 years followed by 75 (37.5%) cases

in the age group of 31-50 years, 15(7.5%) cases in the age group of above 70 years and 7 (3.5%) cases in the age group of 10-30 years. It is observed that the incidence of chronic renal failure reaches its maximum strength during middle age and later part of life.

Table 2: Showing Distribution of Control Cases According to Age Group and Sex

Age Groups (Years)	Number of cases		Total
	Males	Females	
10-30	4	1	5(10.0%)
31-50	12	6	18(36.0%)
51-70	18	9	27(54.0%)
Total	34	16	50(100.0%)

Out of 50 control cases, 34 (68.0%) cases were males and 16 (32.0%) were females. 54.0% were found in the age group 51-70

years, 36.0% were 31-50 years age group and 10.0% were 10-30 years age group.

Table 3: Distribution of C.R.F. Cases According to Duration of Illness

Duration of illness	No. of cases	Percentage %
3 months-6 months	42	21.0%
6 months-1 year	114	57.0%
More than 1 year	44	22.0%
Total	200	100.0%

The majority of chronic renal failure cases were among more than 6 months- 1 year

duration (114 cases, 57.0%) and then more than 1 year children (44 cases, 22.0%).

Table 4: Serum Sodium Level in Normal Healthy Controls

Age in years	Male			Female			Total		
	No.	Range (mmol/L)	Mean±S.D.	No.	Range (mmol/L)	Mean±S.D.	No.	Range (mmol/L)	Mean±S.D.
10-30	4	130-145	137.5±5.59	1	130-145	140.0±2.90	5	130-145	138.0±5.09
31-50	12	132-146	138.0±4.20	6	135-143	138.5±2.81	18	132-146	138.2±3.80
51-70	18	130-150	141.9±5.94	9	135-144	140.8±2.97	27	130-150	141.6±5.18
Total	34	130-150	140.0±5.72	16	130-145	139.9±3.02	50	130-150	140.1±5.02

The highest serum sodium level was observed in the age group of 51-70 years, ranged as 130-150 mmol/L (mean 141.6±5.18mmol/L) followed by the age group of 31-50 years, ranged as 132-146 mmol/L (mean 138.2±3.80mmol/L) and the age group of 10-30 years, ranged as 130-145 mmol/L (mean 138.0±5.09mol/L) respectively. No significant difference was seen among the serum sodium levels of different age groups and sexes. The highest serum sodium level was reported by many

scholars are in very close agreement with our observations [6, 23-26].

The range of serum sodium level before treatment was 120-141 mg/100 ml (mean 136.0±5.28 mg/100 ml). After fifteen, thirty, sixty and ninety days of treatment serum sodium ranged as 122-143 mg/100 ml (mean 137.1±5.22 mg/100 ml), 126-145 mg/100 ml (mean 139.3±5.14 mg/100 ml), 128-148 mg/100 ml (mean 140.5±5.25 mg/100 ml) and 131-152 mg/100 ml (mean 141.3±5.21 mg/100 ml) respectively. No

significant difference was observed in serum sodium as compared to controls.

RESULT AND DISCUSSION

Chronic renal failure is the disease in which kidneys are no longer able to keep the internal environment normal. The alterations in biochemical and clinical signs and symptoms have become more and more questionable. The present study is conducted on a total of 250 individuals, out of which 50 are normal healthy individuals comprising the control group and rest 200 is of chronic renal failure. Results of biochemical parameter like serum sodium from this study are discussed below-

Out of 200 individuals, 128 (64%) controls were male's individuals and rest 72 (36%)

were females. All the 200 individuals were between the age group of 10 above 70 years. The maximum number of cases, 103 (51.5%), were observed in the age group of 51-70 years followed by 75 (37.5%) cases in the age group of 31-50 years, 15(7.5%) cases in the age group of above 70 years and 7 (3.5%) cases in the age group of 10-30 years (**Table 1**). Out of 50 healthy controls, 34 (68%) controls were males' individuals and rest 16 (32%) were females (**Table 2**). It is observed that the incidence of chronic renal failure reaches its maximum strength during middle age and later part of life.

Table 5: Serum Sodium Levels Before and After Treatment in Total Cases of Chronic Renal Failure

Interval	No. of Cases	Serum Sodium	
		Range (mg/100 ml)	Mean \pm S.D.
Control	50	130-150	140.1 \pm 5.02
Before treatment	200	120-141	136.0 \pm 5.28**
15 days after treatment	186	122-143	137.1 \pm 5.22**
30 days after treatment	169	126-145	139.3 \pm 5.14
60 days after treatment	145	128-148	140.5 \pm 5.25
90 days after treatment	122	131-152	141.3 \pm 5.21

P- Significance, control vs treatment, *p < 0.05, **p < 0.01, ***p < 0.001.

Biochemical Studies:

The levels of serum sodium were studied in controls and in all cases of chronic renal failure. The range of serum sodium in healthy subjects was 130-150 mmol/L (mean 140.1 \pm 5.02mmol/L). In males, it was 130-150 mmol/L (mean 140.0 \pm 5.72 mmol/L) and in females, it was 130-145 mmol/L (mean 139.9 \pm 3.02 mmol/L) (Table IV). No significant difference in respect of age and sex was noted in this study. In cases of chronic renal failure, serum sodium was found to be decreased in 48% cases. Before treatment, serum sodium level was 136.1 \pm 5.28 mmol/L which was significantly lower (p < 0.01) as compared to that of controls (140.1 \pm 5.02 mmol/L). Similar observations have been made by many workers [25-28]. Generally hyponatraemia occurs in the patients of chronic renal failure. The hyponatraemia results due to excess urinary loss of sodium and water. The most common pathogenesis of

hyponatraemia is mixed salt and water depletion. Due to salt deficiency cerebral and cardiovascular abnormalities occur. If salt deficiency is not corrected. Patients may die rapidly from peripheral circulatory failure. So, the correction of sodium electrolyte is very important for the improvement of the condition of patients.

SUMMARY AND CONCLUSIONS

The decreased levels of serum sodium were observed in chronic renal failure patients. Before treatment, the levels ranged between 120-141 mmol/L and mean 136.0 \pm 5.28mmol/L. After 15 days of treatment, the levels of serum sodium remained lower but not significant and after 15, 30, 60 and 90 days of treatment the levels returned to normal. The levels ranged as 122-143 mmol/L, 126-145 mmol/L, 128-148 mmol/L and 131-152 mmol/L and mean 137.1 \pm 5.22 mmol/L, 139.3 \pm 5.14 mmol/L, 140.4 \pm 5.25 mmol/L and 141.3 \pm 5.21 mmol/L respectively. In normal

healthy subjects the levels of serum sodium ranged between 130-150 mmol/L and mean 140.1 ± 5.02 mmol/L. In the study group, the levels of serum sodium were found decreased ranging between 121-141 mmol/L and mean 136.0 ± 5.28 mmol/L. Significant difference ($p < 0.01$) was observed among the chronic renal failure patients and controls. The serum sodium level depends on severity of the disease.

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