

ORIGINAL ARTICLE

Evaluative study of electrolytes (serum sodium, potassium, calcium, and phosphorus) disturbance in chronic kidney disease patients

Mohammad Shahrukh¹, Nita Garg², Shikha Saxena³, Afsha Mohi-Ud-Din⁴,
Basant Kumar Joshi¹, Itika Saxena¹

¹Department of Biochemistry, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India, ²Department of Biochemistry, Autonomous State Medical College and Hospital Firozabad, Uttar Pradesh, India, ³Department of Biochemistry, Rohilkhand Medical College and Hospital Bareilly, Uttar Pradesh, India, ⁴Department of Paramedical, Uttranchal (PG) College of Biomedical Science and Hospital, Dehradun, Uttarakhand, India

Corresponding Author:

Dr. Basant Kumar Joshi, Assistant Professor, Department of Biochemistry, Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India.
Mobile: +91-07017747122.
E-mail: mohammadshahrukh.saifi@gmail.com

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The study was conducted on 120 normal patients and 120 chronic kidney disease patients who attended to the OPD/IPD of SMI Hospital, Dehradun. The various biochemical investigations (serum creatinine, serum uric acid, blood urea, serum sodium, serum potassium, serum calcium, and serum phosphorous) of these patients were analyzed. The study revealed that serum creatinine, serum uric acid, blood urea, potassium, and serum phosphorous levels were significantly higher and serum calcium level was slightly lower in study group than control group, but sodium level was not found significant.

KEY WORDS: Chronic kidney disease, Serum creatinine, Serum uric acid, Blood urea, Serum sodium, Serum potassium, Serum calcium, Serum phosphorous

INTRODUCTION

Chronic kidney disease (CKD) appears to be a worldwide health concern.^[1] Chronic renal failure (CRF) is a progressive illness

caused by the kidney's inability to maintain normal low levels of protein metabolism products such as urea, hematocrit, sodium, water, potassium along with normal blood pressure, and acid-base balance.^[2,3] Changes in lifestyle and renal disease pathogenicity may be contributing to the present stage of CKD. Decades back, glomerulonephritis was a key factor in the development of renal disease.^[1] Infections are no longer as common as they formerly were as a cause of renal disease. Furthermore, recent evidence shows that hypertension, progressive nephritic syndrome, diabetes mellitus, chronic hypertension, long-term polycystic kidney disease, and chronic pyelonephritis are the leading causes of kidney disease globally.^[4-6] The all-encompassing term, CKD,

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has been established by the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF KDOQITM).^[7] Patients, families, health-care personnel, and the general public will relate better if “Kidney” is used instead of “Renal”.^[8] The clinical presentation in CRF is associated with changes in water, electrolyte, and acid–base balance.^[9] Diabetes mellitus and hypertension have recently been identified as the major causes of end-stage renal disease (ESRD), accounting for more than 70% of all chronic renal failure.^[10] Electrolyte imbalances frequently lead to neuromuscular and cardiovascular problems, as well as mortality in individuals with chronic kidney failure. In patients with chronic renal disease, timely monitoring of electrolyte imbalance improves survival and reduces morbidity.^[11,12]

Aim and Objectives

Aim

The aim of our study was to estimate serum creatinine, blood urea, serum uric acid, and serum electrolytes in CKD patients.

Objectives

The objectives of this study were as follows:

1. To estimate serum creatinine, blood urea and uric acid in CKD patients and compare with normal subjects.
2. To estimate serum electrolytes levels in CKD patients and compare with normal subjects.

MATERIALS AND METHODS

The samples were taken from the patients who visited OPD/IPD at SMI hospital attached to the Shri Guru Ram Rai Institute of Medical and Health Science, Patel Nagar, Dehradun, for period of 12 months from April 2018 to March 2019. Subjects were recruited according to simple random sampling method that met the selection criteria. The age of persons from >20 years was taken. Both the gender was included in the study. Exclusion criteria were dehydration, smokers, on any medication, alcoholic, CVD, pregnancy, etc., and age <20 and more than 90 years.

All the 240 subjects (120 controls and 120 cases) were analyzed for serum creatinine, blood urea, serum uric acid, and serum electrolytes. All the parameters were estimated on a fully automated analyzer (Vitros-5600).

OBSERVATIONS AND RESULTS

The present study was conducted on 120 normal patients and 120 patients of chronic kidney disease presenting to the OPD/IPD of SMI hospital, Dehradun. The various biochemical investigations of these patients were analyzed.

Table 1 and Chart 1 are showing the comparison of age in cases and normal subjects. In our study, case's age mean value is 55.96 and normal subject's age mean value is 51.25.

Table 2 and Chart 2 are showing gender distribution of cases and normal subjects. In our study, male percentage is 54.10% and

Table 1: Comparison of age (in years) in study group and control group

Parameter	Study group (n=120)	Control group (n=120)
	Mean±SD	Mean±SD
Age (in years)	55.96±16.79	51.25±16.69

Table 2: Gender distribution of CKD patients in the study group and control group

Sex	Study group		Control group	
	Number of patients	% age	Number of patients	% age
Male	65	54.10	58	48.33
Female	55	45.90	62	51.67
Total	120	100	120	100

CKD: Chronic kidney disease

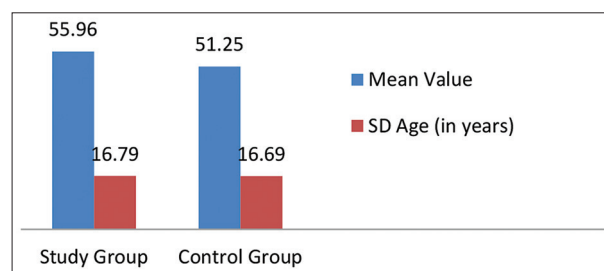


Chart 1: Comparison of age (in years) in the study group and control group

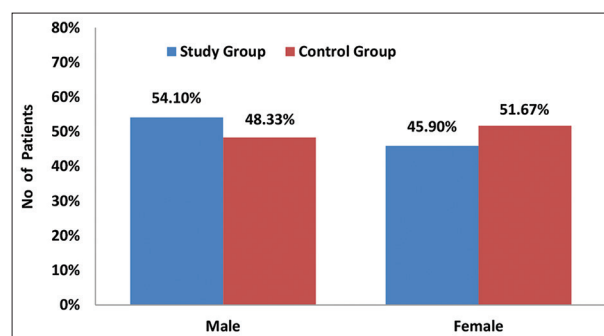


Chart 2: Gender distribution of chronic kidney disease patients in study group and control group

female percentage is 45.90 % in cases of CKD and 48.33 % male and 51.67% female in normal subjects.

Table 3 and Chart 3 are showing the level of urea, creatinine, uric acid, sodium, potassium, calcium, and phosphorus in the patient of CRF.

Serum creatinine, blood urea, and serum uric acid levels in the CRF patients were statistically significantly raised, but serum sodium level in CKD patients was not statistically significant than control group. Serum potassium and phosphorus levels in the CKD patients were significantly higher than the control group. Serum calcium level is slightly lowers in cases than normal subjects.

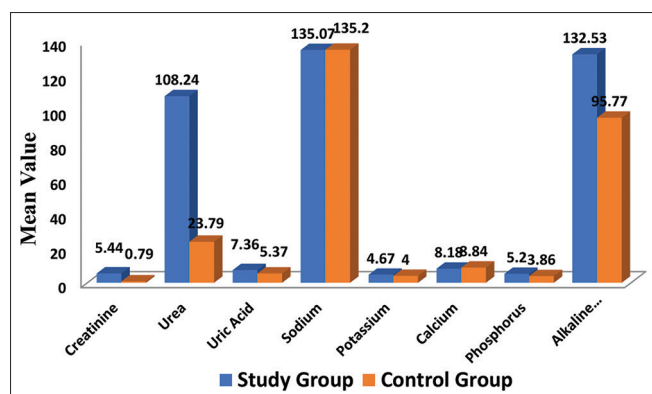
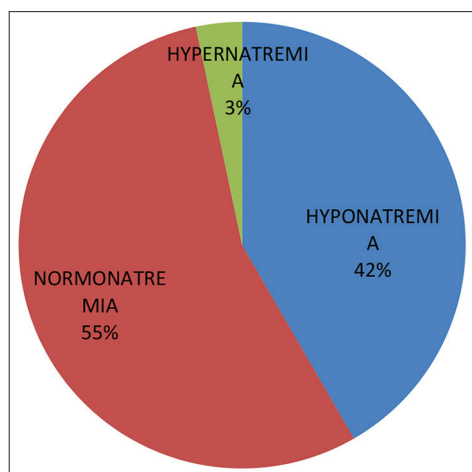
Table 3: Comparison of the various biochemical parameters in the study and control group ($P < 0.05$ is considered as statistically significant)

Parameter	Study group (120) Mean±SD	Control group (120) Mean±SD	t value	P value
Creatinine	5.44±3.99	0.79±0.25	9.23	<0.05*
Urea	108.24±59.23	23.79±11.82	11.19	<0.05*
Uric acid	7.36±3.05	5.37±1.90	4.74	<0.05*
Sodium	135.07±6.27	135.20±16.24	0.08	>0.05
Potassium	4.67±1.01	4.00±0.64	4.80	<0.05*
Calcium	8.18±1.32	8.84±0.66	3.74	<0.05*
Phosphorus	5.20±1.90	3.86±0.94	5.28	<0.05*

Table 4: Distribution of CKD patients according to Serum Sodium levels

Parameter	Disease	No of Patients	Percentage
Sodium (Na)	Hyponatremia	50	42.5%
	Normonatremia	66	55.0%
	Hypernatremia	3	2.5%
	Total	120	100%

CKD: Chronic kidney disease

**Chart 3:** Comparison of the various biochemical parameters in the study and control group.**Chart 4:** Distribution of chronic kidney disease patients according to serum sodium levels**Table 5:** Distribution of CKD patients according to serum potassium levels

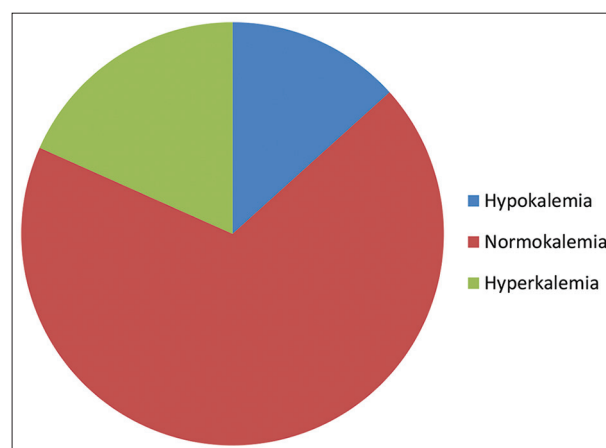
Parameter	Disease	No of patients	% age
Potassium (K)	Hypokalemia	16	13.33
	Normocalcemia	82	68.33
	Hyperkalemia	22	18.33
Total		120	100

CKD: Chronic kidney disease

Table 6: Distribution of CKD patients according to serum calcium levels

Parameter	Disease	Number of Patients	% age
Calcium (Ca)	Hypocalcemia	94	65.00
	Normocalcemia	23	19.16
	Hypercalcemia	3	2.5
Total		120	100

CKD: Chronic kidney disease

**Chart 5:** Distribution of chronic kidney disease patients according to serum potassium levels

CKD patients were again divided into three categories on the basis of serum sodium, serum calcium, serum phosphorous, and serum potassium level.

Table 4 and Chart 4 showing the distribution of 120 CKD patients according to serum sodium level. As shown, 41.366% of the CKD patients were hyponatremic, 3.33% of the patients were hypernatremic, while 55.00% patients had normal sodium level

Table 5 and Chart 5 showing the distribution of the study group according to serum potassium level. As given, 13.33 % of the CKD patients were hypokalemic, 18.33% of the patients were hyperkalemic, while 69.33 % patients had normal potassium levels.

Table 6 and Chart 6 depict the distribution of 120 CKD patients according to serum calcium level. As shown, 65.00% of the CKD patients were hypocalcemic, 2.5% of the patients were hypercalcemic, while 19.16% patients had normal calcium levels.

Table 7: Distribution of CKD patients according to serum phosphorus levels

Parameter	Disease	No of patients	% age
Phosphorus (P)	Hypophosphatemia	3	2.5
	Normophosphatemia	46	38.33
	Hyperphosphatemia	71	59.16
Total		120	100

CKD: Chronic kidney disease

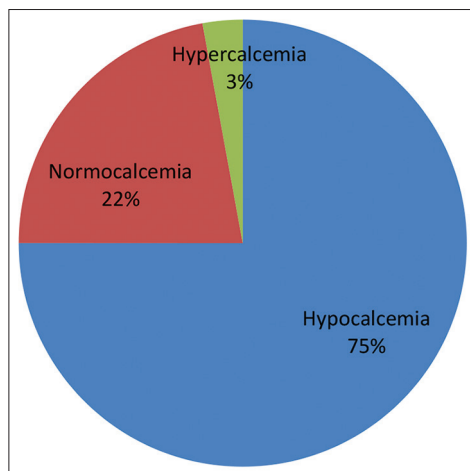
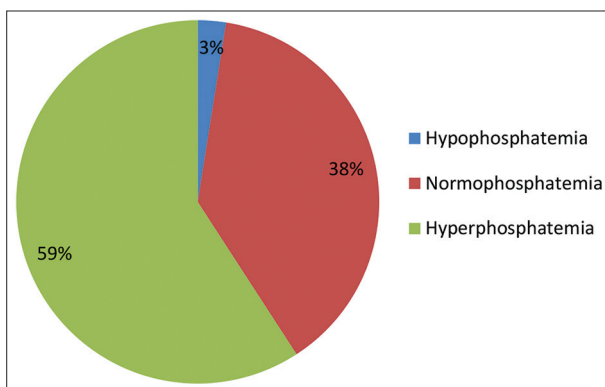
**Chart 6:** Distribution of chronic kidney disease patients according to serum calcium levels**Chart 7:** Distribution of chronic kidney disease patients according to serum phosphorus levels

Table 7 and Chart 7 show the distribution of 120 CKD patients according to serum phosphorus level. As shown, 3% of the CKD patients were hypophosphatemic, 59% of the patients were hyperphosphatemic, while 38% patients had normal phosphorus levels.

DISCUSSION

In our study, we observed the value of serum creatinine (5.44 ± 3.99 mg/dL) level was significantly higher in cases as compared to control group. Mittal *et al.*, Pandya *et al.* and Freethi *et al.* observed almost similar results with 4.6 ± 1.18 mg%,^[11] 7.19 ± 4.77 mg%,^[12] and 4.90 ± 2.23 mg %^[8] was significantly higher in cases as compare to normal subjects.^[13]

Blood urea level (108.24 ± 59.23 mg %) were significantly higher in cases as compared to control group. Mittal *et al.* described almost similar results with a significantly higher level of blood urea which was 136.03 ± 74.6 mg %,^[11] and in 2016, Pandya *et al.*, observed that mean value 112.66 ± 43.52 mg%^[12] was significantly higher in cases as compare to normal subjects.

Serum uric acid level (7.36 ± 3.16 mg %) in the CKD patients was significantly higher than normal subjects. Park *et al.*, observed mean value 7.6 ± 1.8 mg/dL mg %^[14] and Toyama *et al.*, observed that mean value 6.0 ± 1.3 mg %^[15] was significantly higher in cases as compare to normal subjects.

Serum sodium level (135.07 ± 6.27 mmol/L) in CKD patients was not significantly different than the control group. Phukan *et al.*, observed mean value 138.36 ± 8.12 mmol/L^[2] and Ajam observed serum sodium mean value 138.6 ± 4.41 which was not significant in cases as compare to normal subjects.^[16]

Potassium level (4.67 ± 1.01 mmol/L) was in CKD patients approximately similar to that reported by other authors. In our study, serum potassium level in the CKD patients was significantly higher than the control group. Molla observed serum potassium mean value > 5.0 mmol/L in cases as compare to normal subjects.^[17]

Serum calcium level (8.18 ± 1.32 mg/dL) in the CKD patients was significantly lowers than the control group. Phukan *et al.*, observed mean value 8.54 ± 0.49 mmol/L² and Molla observed serum calcium mean value < 2.15 mmol/L in cases as compare to normal subjects.^[17]

Serum phosphorous level (5.20 ± 1.90 mg/dL) in the CKD patients was significantly higher than the control group. Alebiosu *et al.*, observed that mean value was 6.6 ± 3.5 mg %,^[18] and Freethi *et al.*, observed that mean value 4.19 ± 0.404 mg %^[13] was significantly higher than the control group.

CONCLUSION

In the present study, we tried to evaluate the various electrolyte disturbances in the patients of CKD. From the findings of the study, it is evident that the most common electrolyte disturbances are hypocalcemia, hyperphosphatemia, hyponatremia, and hyperkalemia in CKD patients. Managing these disturbances in CKD patients would improve the prognosis of the disease.

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