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Original Article

Clinical Spectrum and Biochemical Profile of Chronic Kidney Disease Patients Attending a Tertiary Hospital Setting in India

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ABSTRACT

Background: The health-care burden due to chronic kidney disease (CKD) has increased worldwide in the past decade. It is associated with many features such as hyperkalemia, hypocalcemia, hyponatremia, hypoalbuminemia, and high blood pressure. By early detection and prompt treatment, we can extend the quality of life of CKD patients. Elucidating the biochemical profile of CKD may help in identifying strategies for prevention and management both in the population and at patient level.

Purpose: The purpose of this study was to assess the clinical spectrum and biochemical profile of the CKD patients.

Materials and Methods: This hospital-based cross-sectional study was conducted at the Department of Nephrology, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India. All the confirmed incident 175 cases of CKD attending the outpatient department (twice a week) and the Department of Nephrology of Sir Sunderlal Hospital, Banaras Hindu University, Varanasi, Uttar Pradesh, India, were considered as the cases of the study. Sociodemographic profile and clinical spectrum of the study participants were obtained by interviewing them. Their biochemical profile was assessed following standard laboratory procedures.

Results: Male-to-female ratio of CKD patients was 2.1:1, and 44.6% of the patients were from urban area. All the 82.3% of the patients were in Stage IV and Stage V. The common clinical manifestations were weakness (90.9%), decreased appetite (82.9%), fatigue (79.4%), bad mouth odor (74.3%), and nausea (61.7%). Burning micturition and decreased urine output were present in 46.9% and 34.3% of the patients, respectively. Weight loss (58.9%) and muscle cramps (53.7%) were other significant manifestations. Hypoalbuminemia, hypocalcemia, hyponatremia, and hypozincemia were present in 38.3%, 60.0%, 33.7%, and 81.7% of the patients, respectively, whereas 40.0% of the patients had hyperphosphatemia. There existed a significant association in the stages of CKD and serum urea, creatinine, uric acid, and phosphorus.

Conclusion: Clinical and biochemical profile provided a significant input for the management of CKD.

Key words: Chronic kidney disease, Diabetes, End-stage renal disease, Glomerular filtration rate, Hypertension

INTRODUCTION

Chronic kidney disease (CKD) is characterized by a decrease in glomerular filtration rate (GFR) and histological evidence of reduction in nephron population.[1] India is projected to become the major reservoir of chronic diseases such as diabetes mellitus and hypertension; 20-40% of these patients may develop CKD. India is experiencing a rapid health transition with large and rising burden of non-communicable diseases, which are estimated to account for 53% of all deaths and 44% of disability-adjusted life years lost in 2005.[1] India is presently having the maximum number of patients with diabetes, earning the term of "diabetes capital of the world". According to the diabetes atlas 2006, published by the International Diabetes Federation, the number of patients with diabetes in India is around 40.9 million, and unless urgent preventive measures are instituted, it is expected to rise to 69.9 million by 2025.[2] There

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are only few population-based studies in India that reported on the magnitude of CKD.[3-5]

There are multiple causes of kidney injury that lead to the final common pathway of end-stage renal disease (ESRD), and this syndrome is characterized by hypertension, anemia, renal bone disease, nutritional impairment, neuropathy, impaired quality of life, and reduced life expectancy.[3,4] CKD is emerging in the 21st century as a global public health issue. According to the World Health Report 2002 and Global Burden of Disease Project, diseases of kidney and urinary tract contribute to the global burden of disease, with approximately 850,000 deaths every year and 15,010,167 disability-adjusted life years in the whole world. CKD has emerged as the 12th leading cause of death and 17th cause of disability.[6-8] Clinically, CKD is suspected when prolonged symptoms and signs of uremia are present (for usually >3 months). On laboratory investigations, there will be elevation of serum urea and serum creatinine. Presence of broadcasts in urine is an important diagnostic clue. It is associated with many features such as hyperkalemia, hypocalcemia, hyponatremia, anemia, hypoalbuminemia, and high blood pressure. Thus, by ensuring these features early, we can start remedial measures early and we can extend the quality of life of the CKD patients. Elucidating clinical spectrum and biochemical profile of CKD patients may help in identifying strategies for prevention, both in the population and in the individual patient level.

MATERIALS AND METHODS

This study was conducted at the Department of Nephrology, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India. This was an hospital-based cross-sectional study. Clinically stable, non-dialyzed 175 incident CKD patients from Stage II to V under treatment in the Department of Nephrology, Sir Sunderlal Hospital, Banaras Hindu University (BHU), Varanasi, were considered as study participants.

Sampling Methodology

All the confirmed incident cases of CKD attending the outpatient department (twice a week) and indoor cases attending the Department of Nephrology of Sir Sunderlal Hospital, BHU, Varanasi, were selected as the participants of the study.

Inclusion Criteria

All patients of CKD who fulfill the following criteria were included in the study:

1. Serum creatinine level <6 mg/dl
2. Clinical and biochemical evidence of chronic renal failure (serum creatinine >1.5 mg % and urea >40 mg/d for >3 months).

Exclusion Criteria

1. Patients with acute CKD
2. Patients with other conditions such as malignancy, advance renal disease, or any other chronic illness were excluded from the study.

Ethical Clearance

The protocol of the study was approved by the Institutional Ethical Committee, Institute of Medical Sciences, Banaras Hindu University, Varanasi, and all the patients gave consent before entering the study.

Tools of the Study

Pretested and predesigned interview schedule was used for collection of data. Libra weighing machine was used for weight recording. Its accuracy was checked from time to time against known weight. Fully automatic analyzer (RFCL, Flexor-XL) was used to analyze the biochemical parameters of the study participants.

Techniques of the Study

Age and sex of the study participants were recorded on the predesigned and pretested pro forma.

Their biochemical parameters were assessed by fully automatic analyzer (RFCL, Flexor – XL). GFR, based on age, weight, and creatinine, was calculated separately for men and women by using the following formula (Cockroft–Gault equation):[9]

$$\text{GFR for men} = \frac{(140 - \text{age}) \times \text{weight}}{72 \times \text{creatinine (mg/dl)}}$$

$$\text{GFR for women} = \frac{(140 - \text{age}) \times \text{weight}}{72 \times \text{creatinine (mg/dl)}} \times 0.85$$

The cases with GFR ≥120 mL/min/1.73 m^2 were considered normal.

Statistical Analysis

Data thus collected were entered in a personal computer and analysis was done using SPSS software version 16. Data are shown as mean ± standard deviation for the quantitative variables in the study.

Analysis of variance was applied for drawing inferences.

RESULTS

Out of the total 175 study participants, 119 (68.0%) were males and 56 (32.0%) were females, sex ratio being 2.1:1. Ninety-two (52.6%) patients were in the age group of 45-65 years, followed by 21.7% in the age group of >65 years, and 16% in the age group of 25–44 years (Table 1). Majority of the patients (92.0%) were Hindu by religion and rest (8.0%) were Muslim. Out of the total 175 participants, 77 (44.0%) were from other caste category, 73 (41.7%) belonged to other backward category (OBC), and rest 25 (14.3%) were from SC/ST categories. Ninety-seven (44.6%) study participants were from rural area. Of the total 175 cases, 18.3% were in service, 16% were farmers, and 10.9% were businessperson. Of the 56 females, 44 (78.6%) were primarily engaged in domestic work. Majority (87.4%) of the patients were married. One hundred and two (58.3%) patients were from nuclear family. In case of 96 (54.9%) patients, the family size was >6.

Table 1: Age and gender wise distribution of the study participants

Age group	*n* (%)		
	Male	Female	Total
<24	7 (5.1)	10 (17.9)	17 (9.7)
25-44	12 (10.1)	16 (28.6)	28 (16.0)
45-64	66 (55.5)	26 (21.9)	92 (52.6)
>65	34 (28.6)	4 (7.1)	38 (21.7)
Total	119 (100.0)	56	175

As much as 76.5% male and 94.6% female CKD patients were in Stage IV and Stage V. Totally 82.3% of the patients were in these categories (Table 2).

The common clinical manifestations of CKD patients were weakness (90.9%), decreased appetite (82.9%), fatigue (79.4%), bad mouth odor (74.3%), constipation (72.6%), and nausea (61.7%). Burning micturition and decreased urine output were present in 46.9% and 34.3% of the patients, respectively. Weight loss (58.9%) and muscle cramps (53.7%) were significant manifestations. There existed wide variations in the durations of clinical manifestations of CKD patients. This was maximum for burning micturition (52.26 ± 178.02 weeks) and least for cough (7.47 ± 5.95 weeks) (Table 3).

Nearly half (53.7%) of the CKD patients were hypertensive. As much as 40.0%, 13.1%, 4.6%, and 4.0% of the patients had diabetes mellitus, gout, obstructive uropathy, and urinary tract infection, respectively (Figure 1). The mean duration of diabetes and hypertension in CKD patients was 177.31 ± 367.41 and 129.25 ± 269.12 weeks, respectively.

Table 2: Distribution of patients according to glomerular filtration rate

Stages of CKD	*n* (%)		
	Male	Female	Total
Stage II	4 (3.4)	0	4 (2.3)
Stage III	24 (20.2)	3 (5.2)	27 (15.4)
Stage IV	69 (57.9)	27 (48.2)	96 (54.9)
Stage V	22 (18.5)	26 (46.4)	48 (27.4)
Total	119 (100)	56 (100)	175 (100)

CKD: Chronic kidney disease

Table 3: Clinical manifestations of the study participants

Manifestation	Present, *n* (%)	Duration (mean±SD) in weeks	Range
Weakness	159 (90.9)	20.25±28.49	1-208
Decrease appetite	145 (82.9)	18.93±16.70	2-104
Fatigue	139 (79.4)	14.56±19.07	1-104
Bad mouth odor	130 (74.3)	15.45±16.10	1-104
Constipation	127 (72.6)	45.63±73.96	2-520
Nausea	108 (61.7)	12.84±16.42	1-104
Weight loss	103 (58.9)	51.22±82.73	2-520
Swelling lower limb	99 (56.6)	36.16±89.47	2-520
Vomiting	98 (56.0)	14.76±21.63	1-104
Breathlessness on exertion	96 (54.9)	23.77±32.97	1-158
Muscle cramps	94 (53.7)	23.32±33.58	2-208
Burning micturition	82 (46.9)	52.26±178.02	2-1040
Tingling/numbness	68 (38.9)	26.83±66.25	1-520
Joint pain	66 (37.7)	40.43±83.00	3-560
Decrease urine output	60 (34.3)	40.15±86.02	2-416
Fever	58 (33.1)	8.98±14.06	1-104
Itching	58 (33.1)	20.65±71.55	1-520
Headache	49 (28.0)	10.77±9.06	1-32
Cough	35 (20.0)	7.47±5.95	1-24
Swelling whole body	34 (19.4)	15.58±16.22	1-104
Hematuria	20 (11.4)	33.00±33.71	1-104
Swelling abdomen	14 (8.0)	21.85±17.40	2-52
Breathlessness at rest	11 (6.3)	27.33±37.98	2-104

SD: Standard deviation

Biochemical profile of CKD patients is shown in Table 4. Majority (70.3%) of the patients had urea level in the range of 46-125 mg/dl. Only 6.9% of the patients had urea level <45 mg/dl. Nearly one-third (33.7%) of the patients had creatinine level >4 mg/dl. In case of 5.7% of the patients, creatinine value ranged from 0.5 to 1.6 mg/dl.

As much as 38.9% and 58.2% of the patients had total protein level <6.7 g/dl and 6.7-8.6 g/dl, respectively. In case of 58.9% and 38.3% of the patients, serum albumin level was 3.6-5.5 g/dl and <3.5 g/dl, respectively. Majority, i.e. 76.6% of the patients had serum globulin level between 1.5 and 3.5 g/dl. None of the CKD patients had this value <1.5 g/dl. Only 12.0% of the patients had serum alkaline phosphatase level <108 IU/dl; 61.7% and 26.3% of the patients had this value in the range of 108-306 IU/dl and >306 IU/dl, respectively. Majority (90.3%) of the patients had cholesterol level <200 mg/dl. In case of 38.9% of the patients, triglyceride level was ≥150 mg/dl. Low-density lipoprotein (LDL) level was ≥70 mg/dl in 50.9% of the patients. In case of 58.3% of the patients, high-density lipoprotein (HDL) was <40 mg/dl. Three out of five (60.0%) patients had calcium level <8.5 mg/dl. Majority (94.3%) of the patients had phosphorus level more than 2.5 g/dl. In case of 57.1% of the patients, sodium level was in the range of 135-145 mEq/L. Hyponatremia (Na <135 mEq/L) and hypernatremia (Na >145 mEq/L) were present in 33.7% and 9.1% of the patients, respectively. Majority, i.e., 73.1% of the patients had potassium level in the range of 3.5-5.5 mEq/L. Hypo- and hyper-kalemia were present in 11.0% and 9.1% of the patients, respectively. Majority (92.6%) of the patients had low chloride level. Nearly half (48.0%) of the patients had magnesium value between 1.5 and 2.3 mg/dl; in 30.9% of the patients, this was <1.5 mg/dl. In majority of the patients (81.1%), zinc level was <75 µg/dl. In 93.1% of the patients, serum copper level was within normal range (70-140 µg/dl).

There existed a significant association between the stage of CKD and blood urea ($P < 0.01$). Blood urea levels were not statistically different ($P > 0.05$) between Stage II (41.07 ± 10.56 mg/dl) and Stage III (68.44 ± 31.43 mg/dl). Compared to these groups, urea levels were significantly more in Stage IV (102.93 ± 43.40 mg/dl) and Stage V (118.67 ± 47.19 mg/dl). Urea level was significantly ($P < 0.05$) different in Stage IV and V. In comparison to Stage II (1.23 ± 0.19 mg/dl) and Stage III (2.14 ± 0.55 mg/dl), serum creatinine level was significantly ($P < 0.01$) more in Stage IV (3.36 ± 1.12 mg/dl)

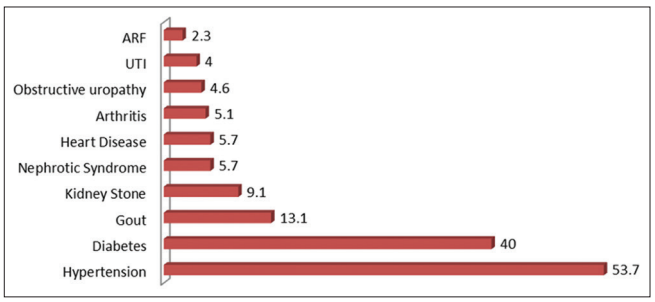

Figure 1: Associated diseases with chronic kidney disease

Table 4: Biochemical profile of the study participants (*n*=175)

Parameters	*n* (%)
Urea (mg/dl)	
<45	12 (6.9)
46-85	61 (34.9)
86-125	62 (35.4)
126-165	24 (13.7)
>166	16 (9.1)
Creatinine (mg/dl)	
0.5-1.6	10 (5.7)
1.61-1.99	12 (6.9)
2.00-2.99	44 (25.1)
3.00-3.99	50 (28.6)
>4	59 (33.7)
Total protein (g/dl)	
<6.7	68 (38.9)
6.7-8.6	102 (58.2)
>8.6	5 (2.9)
Albumin (g/dl)	
≤3.5	67 (38.3)
3.6-5.5	103 (58.9)
≥5.6	5 (2.9)
Globulin (g/dl)	
<1.5	0
1.5-3.5	134 (76.6)
>3.5	41 (23.4)
ALP (IU/dl)	
<108	21 (12)
108-306	108 (61.7)
>306	46 (26.3)
Cholesterol (mg/dl)	
<200	158 (90.3)
200-239	9 (5.1)
>240	8 (4.6)
Triglyceride (mg/dl)	
<150	107 (61.1)
150-199	46 (26.3)
>200	22 (12.6)
LDL (mg/dl)	
<70	86 (49.1)
70-100	57 (32.6)
100-129	17 (9.7)
130-159	8 (4.6)
160-189	0 (0)
>190	7 (4)
HDL (mg/dl)	
<40	102 (58.3)
40-60	55 (31.4)
>60	18 (10.3)
Calcium (mg/dl)	
<8.5	105 (60)
8.5-11	68 (38.9)
>11	2 (1.1)
Phosphorus (mg/dl)	
<2.5	10 (5.7)
2.5-4.5	95 (54.3)
>4.5	70 (40.0)
Sodium (mEq/l)	
<135	59 (33.7)
135-145	100 (57.1)
>145	16 (9.1)
Potassium (mEq/l)	
<3.5	19 (10.9)
3.5-5.5	128 (73.1)
>5.5	16 (16)
Chloride (meg/l)	
<116	162 (92.6)
116-122	5 (2.9)
>122	8 (4.57)
Iron (µg/dl)	
<41	35 (20.0)
41-141	131 (74.9)
>141	9 (5.14)
Magnesium (mg/dl)	
<1.5	54 (30.9)
1.5-2.3	84 (48.0)
>2.3	37 (21.1)
Zinc (µg/dl)	
<75	142 (81.1)
75-120	32 (18.3)
>120	1 (0.6)
Copper (µg/dl)	
<70	1 (0.6)
70-140	163 (93.1)
>140	11 (6.3)

LDL: Low-density lipoprotein, HDL: High-density lipoprotein, ALP: Alkaline phosphates

and Stage V (4.53 ± 1.77 mg/dl). Serum creatinine level was significantly ($P < 0.01$) less in Stage IV than in Stage V. Uric acid was least in Stage II (5.58 ± 2.22 mg/dl) and maximum in Stage III (7.57 ± 1.79 mg/dl). Overall, there existed a significant association between the stage of CKD and uric acid level ($P < 0.05$).

There existed no significant ($P > 0.05$) association between the stages of CKD and total protein, serum albumin, and serum globulin.

Serum total cholesterol, triglyceride, HDL, and LDL were not significantly ($P > 0.05$) different in various stages of

CKD. Serum calcium, potassium, and chloride levels were similar ($P > 0.05$) in different stages of CKD. In comparison to Stage II (2.65 ± 0.77 mg/dl), serum phosphorus levels were significantly ($P < 0.05$) more in CKD Stages III (4.41 ± 1.46 mg/dl), IV (4.49 ± 1.39 mg/dl), and V (4.80 ± 1.69 mg/dl).

There was no significant difference in phosphorus level between Stage III versus Stage IV and V and Stage IV versus V. In comparison to Stage II (148.95 ± 12.39 mEq/L), serum sodium level was significantly less for Stages III, IV, and V of CKD. Serum sodium level was similar in Stages III, IV, and V (Table 5).

The average value of blood urea and serum creatinine was 100.81 ± 45.82 mg/dl and 3.45 ± 1.30 mg/dl, respectively. The mean value of total protein in the present study was 6.95 ± 0.93 g/dl. The average value of serum albumin was 3.75 ± 0.60 g/dl. In the present study, the mean value of serum cholesterol, triglyceride, HDL, and LDL was 153.91 ± 48.02 mg/dl, 131.92 ± 59.98 mg/dl, 40.68 ± 14.19 mg/dl, and 76.06 ± 40.18 mg/dl, respectively. The mean value of very LDL (VLDL) cholesterol was 28.65 ± 22.26 mg/dl. Average serum calcium and phosphorus levels were 8.17 ± 1.39 mg/dl and 4.52 ± 1.51 mg/dl, respectively. According to this study, the mean value of serum sodium and potassium level was 136.97 ± 8.69 mEq/L and 4.70 ± 0.96 mEq/L, respectively (Table 6).

DISCUSSION

This study reveals that with advancing age, there has been an increase in the occurrence of CKD. Further, there is preponderance of male patients with male-to-female ratio of 2.1:1. Since this is a hospital-based study, the demographic trends may not be representative of the prevailing situation in the general population. In comparison to census figure, there had been under representation of Muslim patients. Urban population comprises 30% of the total population. Contrary to this, in the present observation, 9 out of 20 patients were from urban area. Engagement in gainful employment was inadequate for female patients; this is supported by an observation that nearly 8 out of 10 female patients were engaged in domestic work.

The clinical course of CKD is typically one of the progressive and unrelenting losses of nephron function, ultimately leading to ESRD. In the present study, 3 out of 4 male and 19 out of 20 female patients were in Stage IV and V, respectively, signifying thereby delayed reporting of these cases to a tertiary institution. The common manifestations of CKD as observed in this study can be utilized in creating awareness about the disease in the population. If it happens, this is likely to alter their health-seeking behavior, and if the health system is geared up, CKD can be diagnosed at early stage.

In a study on Stage V CKD patients, lack of energy, pruritus, drowsiness, dyspnea, edema, pain, dry mouth, muscle cramps, restless leg, lack of appetite, poor concentration, etc., were the common symptoms.[10] Contrary to this, a study from Hyderabad identified fever as the most common clinical symptom.[11] According to another study, lack of energy, itching, joint pain, muscle cramps, dry mouth, constipation, swelling in legs, and restlessness were the common symptoms.[12] A high prevalence of hypertension and anemia has been reported in a study conducted in South India.[13] One out of the five study subjects reported feeling of numbness or tingling of feet. All these studies including the work done by researcher point that there is a wide variation in the manifestations of CKD patients. Such symptoms are not specific to CKD. Many other diseases may produce similar symptoms. Therefore, it becomes necessary to evolve the algorithm of symptomatology so that this can serve as a tool for the early detection of patients at risk of CKD.

Nearly half of the CKD patients included in the study subject were hypertensive and two out of five had diabetes mellitus. The etiological role of diabetes mellitus, hypertension,

Table 5: Glomerular filtration rate wise distribution of biochemical profile of chronic kidney disease patients

Parameter	GFR wise distribution					
	Mean±SD				Test of significance	
	Stage II (*n*=4)	Stage III (*n*=27)	Stage IV (n=96)	Stage V (*n*=48)	*F*	*P*
Blood urea (mg/dl)	41.07±10.56	68.44±31.43	102.93±43.40	118.67±47.19	10.72	0.000
Creatinine (mg/dl)	1.23±0.19	2.14±0.55	3.36±1.12	4.53±0.97	41.11	0.000
Uric acid (mg/dl)	5.58±2.22	7.57±1.79	6.79±2.04	7.46±1.77	2.68	0.049
Total protein (g/dl)	7.53±0.69	7.01±0.64	6.83±0.93	7.04±1.06	1.15	0.331
Albumin (g/dl)	4.32±0.29	3.90±0.73	3.68±0.62	3.76±0.57	2.33	0.076
Globulin (g/dl)	3.20±0.80	3.02±0.50	3.09±0.73	3.28±0.75	0.83	0.481
Total cholesterol (mg/dl)	167.25±31.53	157.21±48.21	153.28±45.41	150.54±54.70	0.22	0.881
Triglycerides (mg/dl)	117.50±69.13	130.65±70.74	132.00±57.01	131.43±58.75	0.08	0.973
HDL (mg/dl)	44.25±18.32	37.08±8.93	40.20±13.78	43.46±16.70	1.32	0.270
LDL (mg/dl)	99.63±19.63	72.70±48.10	75.70±28.03	75.61±41.18	0.52	0.669
VLDL (mg/dl)	23.48±13.78	24.58±14.34	28.03±12.72	31.93±36.82	0.74	0.531
Calcium (mg/dl)	8.55±0.71	8.39±1.11	8.17±1.30	7.87±1.76	0.92	0.430
Phosphorus (mg/dl)	2.65±0.77	4.41±1.46	4.49±1.39	4.80±1.69	2.78	0.043
Sodium (mEq/dl)	148.95±12.39	138.79±6.28	137.01±8.23	134.96±9.55	4.00	0.009
Potassium (mEq/dl)	4.06±0.22	4.55±0.69	4.74±0.99	4.76±1.01	0.96	0.414
Chloride (mEq/dl)	106.82±10.38	102.08±6.62	101.23±8.29	101.06±9.12	0.66	0.579

GFR: Glomerular filtration rate, SD: Standard deviation, VLDL: Very low-density lipoprotein, LDL: Low-density lipoprotein, HDL: High-density lipoprotein

Table 6: Mean of biochemical profile of chronic kidney disease patients

Parameters	Mean±SD
Blood urea (mg/dl)	100.81±45.82
Serum creatinine (mg/dl)	3.45±1.30
Total protein (g/dl)	6.95±0.93
Albumin (g/dl)	3.75±0.60
Globulin (g/dl)	3.18±0.71
Total cholesterol (mg/dl)	153.91±48.02
Triglycerides (mg/dl)	131.92±59.98
HDL (mg/dl)	40.68±14.19
LDL (mg/dl)	76.06±40.18
VLDL (mg/dl)	28.65±22.26
Sodium (mEq/L)	136.97±8.69
Potassium (mEq/L)	4.70±0.96
Calcium (mg/dl)	8.17±1.39
Phosphorus (mg/dl)	4.52±1.51
ALP (IU)	101.46±8.30
Uric acid (mg/dl)	7.05±1.95
Zinc (µg/dl)	57.29±22.54
Copper (µg/dl)	110.48±19.82
Magnesium (mg/dl)	1.82±0.54

ALP: Alkaline phosphates, VLDL: Very low-density lipoprotein, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, SD: Standard deviation

and obstructive neuropathies has been reported in a study conducted in South India.[13] In comparison to the observed average value of serum urea in this study, higher values were reported by several workers.[7,14,15] However, lower urea levels were also reported by some workers.[16,17] In comparison to the present study high level of serum creatinine has been observed by several workers[14-17] whereas lower values were also reported in some studies.[18-20]

The average total serum protein of patients included in this study was lower than the value reported in other studies.[21] The observed value of serum albumin was in conformity with the findings reported by several workers.[16,17,19,22] Other studies reported higher level of albumin[21,23] and a lower value was found by the study done by Paudel *et al*.[7]

The observed value of serum cholesterol was lower than the figures reported in several studies.[14,20,22] Average triglyceride level as observed in this study was higher than the figure reported in another study[24] whereas other studies reported lower triglyceride values than the present study.[14,20,22] Average HDL value in the present study was higher than the values reported in another study[24] whereas lower values of HDL were reported in several studies.[14,20,22] Value of LDL cholesterol was lower than the values reported by several workers.[14,20,22,24] The mean value of VLDL cholesterol was lower than the values reported by another study.[20]

The average serum calcium level observed in the present study was similar with the reported figures of other studies.[7,24] Higher values of serum calcium in CKD patients have been claimed in various studies.[14,16,17,19,25] Serum phosphorus value of CKD patients included in this study was higher than the values reported by the several workers.[18,19,25] Higher level of serum phosphorus was reported in other studies.[7,16,17] The mean serum sodium level observed in this study was higher than the reported values of the several studies done earlier.[7,14,15,24]

Average serum potassium of CKD patients including this study was almost similar to the reported figures to other studies.[7,14,15,24] Zinc plays a very significant role in human nutrition in general and high level of zinc deficiency in CKD patients emphasizes the need for zinc supplementation.

Variations in biochemical parameters in different studies could be primarily due to stage of reporting of CKD patients in different settings and their health status prior to the development of CKD.

CONCLUSION

There is a need and scope for evolving algorithms based on common manifestations of CKD. Clinical manifestations and biochemical variations in profile in study subjects provide a significant input for the management of patients of CKD.

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