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Original Article

Evaluation of Hematological and Biochemical Parameters in Patients with CKD: A Case control Study

Modi Deepika[1], Modi Jayesh[2], Agarwal Shalaka[3], Dinkar Sunita[4]

Author Affiliation: [1]Assistant Professor, Department of pathology, [2]Associate professor, Department of Surgery, [3]Tutor, Department of Biochemistry, [4]Professor, Department of Surgery, Banas Medical College & Research Centre, Palanpur 385001 Gujarat, India.

Corresponding Author:
Modi Jayesh, Associate professor, Department of Surgery, Banas Medical College & Research Centre, Palanpur. 385001 Gujarat, India.

Email: drjayesh_modi@gmail.com

Abstract

Background: Chronic kidney disease (CKD) is associated with variety of hematological and biochemical abnormalities. The present study aimed to assess the hematological and biochemical parameters of patients with CKD and to compare the results to those of a control population.

***Material and Methods*:** This was a prospective Case control study sectional study included patients of age >16 years, diagnosed with CKD, and serumcreatinine level >1.5 mg/dL. Age-sex matched healthy volunteers were taken as control. Hematological investigations and biochemical tests were compared between CKD and control group. All statistical analyses were performed using SPSS software (version 23).

***Results*:** A total of 70 patients with CKD and 62 control participants were enrolled. Hematological parameters including hemoglobin, packed cell volume, mean cell hemoglobin, mean corpuscular hemoglobin concentration, and platelet count were significantly reduced in CKD group compared to control group. White blood cell indices including total leucocyte count, neutrophils, lymphocytes, and monocytes were significantly decreased in CKD group than control group. All the biochemical parameters including serum creatinine, pre-urea all the biochemical parameters including serum creatinine, urea, potassium and phosphorous were significantly increased in CKD group comopared to controls whereas sodium was significantly decreased in CKD group as in comparision to controls, sodium, potassium, and phosphorous were significantly increased in CKD group compared to controls..

***Conclusion*:** Patients with CKD showed a specific profile of hematologicalandbiochemical parameters. A good understanding of the differences in our cohort with those in the general population might aid in the clinical follow-up of patients with CKD.

Keywords: Hemodialysis, Rbc Indices, Platelet Count, Total Leucocyte Cout.

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Introduction

Chronic kidney disease (CKD) is a global health burden with leading cause of mortality and morbidity. CKD isfound to be associated with many comorbidities including diabetes, anemia, liver and cardiovascular diseases.[1] Recent data reported that prevalence of CKD predominant in Asian countries compared to Western world.[2,3] CKD is highly prevalent in India but its etiology varies considerably.The reportedincidence of CKD ranges from <1% to 13%in different regions of India, and recently, data from north India reported a prevalence as high as 17.4%.[4,5]

Kidney Kidney diseases are associated with significant impairmentin various biochemical and hematological parameters. Hematological parameters including RBC indices, total leukocyte count (TLC), white blood cells count, and platelet count are deranged in CKD. Anemia parallels the degree ofrenal impairment and the most important cause is failureof renal erythropoietin secretion. Other factors include chronic blood loss, hemolysis and bonemarrow. There is a proportional increase in the prevalence and severity of hematological impairment with increasing severity of kidney dysfunction. Derangement in biochemical parameters including sodium, potassium, calcium, magnesium and chloride in CKD may be life threatening, hence these parameters must be maintained within physiological range.[6,7]

The impact of CKD on hematological and biochemical abnormalities has been evaluated in previous studies. Though these findings are inconsistent, more studies are needed to determine that hematological and biochemical parameters can be used as markers to diagnose the patients with CKD.Therefore, present study aimed to assess the hematological profile and biochemical parameters of patients with CKD and compared the results with results of healthy individuals as control.

Materials and Methods

Study design

This was a prospective cross-sectional study conducted at the Department of Pathology, Banas Medical College Research Institute, (Palanpur), Gujarat between May 2018 and December 2020. The study was approved by Institutional Ethics Committee and study procedure was in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all study patients before enrolment.

Study population

Patients of age >16 years, diagnosed with CKD based on KDIGO guidelines CKD is defined as either kidney damage marked by albuminuria and GFR less than 60 mL/min per 1.73 m2 for ≤3 months),[8] May or may not be on hemodialysis, and serumcreatinine level more than 1.5 mg/ dL were included in this study. Patient suffering from preexisting blood disorders, stone disease and patients suffering from muscular atrophy and serum creatinine<1.5 mg/dL were excluded. Sixty-two age-sex matched healthy volunteers were taken as control.

General data including age and sex was collected. Hematological investigations including RBC, hemoglobin, TLC, platelet count, PCV, MCV, MCHC, RDW, WBCs were recorded using Beckman coulter automatic analyzer. Biochemical tests including serum creatinine, urea, sodium, potassium, calcium, phosphorus,were tested. All of these tests were done by automated biochemistry analyzer (Erba Transasia-EM-200).

Statistical analysis

All statistical analyses were performed using SPSS software (version 23). The qualitative data were expressed as number and proportions while the quantitative data were expressed as mean (SD). Categorical and continuous variables were compared with Chi-square test and Mann-Whitney U test, respectively. Statistical significance was defined as P <0.05.

Results

A total of 70 patients with CKD and 62 participants as control were included in this study. The male and female ratio was comparable between both the groups (Table 1).

Table 1: Age and sex distribution between CKD and control groups.

Characteristics	CKD group (N=70)	Control Group (N=62)	P value
Age (years)	47.0 (12.0)	42.4 (11.1)	0.0245
Age group (years), n(%)			
16-30	12 (17.1)	16 (25.8)	0.2239
31-45	21 (30.0)	20 (32.3)	0.7765
46-60	27 (38.6)	21 (33.9)	0.5768
>60	10 (14.3)	5 (8.1)	0.2649

Sex, n (%)			
Male	42 (60.0)	40 (64.5)	0.5962
Female	28 (40.0)	22 (35.5)	0.5962

Data shown as n (%), unless otherwise specified.

The mean hemoglobin was significantly reduced in CKD group compared to control group (9.2 g/dL vs. 13.2/dL; P<0.0001). There was significant reduction in mean PCV, MCH, and MCHC in CKD group than control group (P<0.0001). The platelet count was significantly reduced in patients from CKD group compared to controls (P=0.0005). The total leucocyte count, neutrophils, lymphocytes, and monocytes were reduced in CKD group and it was statistically significant. However, the mean RBC count, MCV, RDW, and eosinophil were comparable between CKD and control group (Table 2).

Table 2: Comparison between hematological parameters in CKD and control groups.

Parameters	CKD group (N=70)	Control Group (N=62)	P value
Hemoglobin (g/dL)	9.2 (1.3)	13.2 (1.7)	<0.0001
RBC count (Million/ mm3)	3.7 (0.6)	3.9 (0.8)	0.1043
PCV (L/L)	31.4 (3.9)	35.3 (3.8)	<0.0001
MCV (fl)	90.2 (6.7)	91.3 (5.3)	0.3017
MCH (pg)	29.3 (3.2)	32.4 (4.1)	<0.0001
MCHC (g/dL)	33.5 (1.2)	34.4 (0.9)	<0.0001
RDW (%)	13.6 (1.3)	13.2 (1.2)	0.0697
Platelet count (cells/µL)	182,150 (74,342)	231,420 (85,231)	0.0005
TLC, (cells/L)	7130.0 (2932.3)	4621.3 (1272.6)	<0.0001
Neutrophils (%)	69.2 (7.1)	57.1 (6.2)	<0.0001
Lymphocytes (%)	31.5 (7.9)	25.2 (4.2)	<0.0001
Monocyte (%)	6.0 (3.2)	5.0 (2.2)	0.0409
Eosinophil (%)	3.0 (4.5)	2.0 (2.1)	0.1117

Data represented as mean (SD).
MCH, mean cell hemoglobin; MCHC, mean corpuscular hemoglobin concentration; MCV, mean cell volume; PCV, packed cell volume; RBC, red blood cell; RDW, red cell distribution width; TLC, total leukocyte count.

All the biochemical parameters including serum creatinine, pre-urea, sodium, potassium, and phosphorous were significantly increased in CKD group compared to controls whereas the mean calcium level was comparable between the groups (Table 3).

Table 3: Comparison between biochemical parameters in CKD and control groups.

Parameters	CKD group (N=70)	Control Group (N=62)	P value
Serum creatinine (mg/dL)	12.4 (2.5)	0.73 (0.2)	<0.0001
Pre-urea	128.5 (34.2)	15.3 (3.2)	<0.0001
Sodium (mEq/L)	133.1 (3.8)	138.4 (4.2)	<0.0001
Potassium (mmol/L)	5.1 (0.8)	3.3 (0.4)	<0.0001
Calcium (mg/dL)	8.0 (1.2)	8.2 (1.3)	0.3598
Phosphorous (mg/dL)	5.4 (2.1)	4.0 (0.9)	<0.0001

Data represented as mean (SD).

Discussion

Change in hematological and biochemical markers are associated with renal dysfunction and this can be worsen with progression of disease whichfurthercomplicate the condition of the patient, becoming risk factor for cardiovascular complications. The present study evaluated several hematological and biochemical parameters in patients with CKD. A total of 70 patients with CKD and 62 control populations were enrolled. The mean age was significantly higher in CKD group compared to controls (P=0.0245). The mean hemoglobin was significantly reduced in CKD groupcompared to control group. This finding was in accordance with the previous studies.[9] Previous studies showed significant decreased in RBC count in patients with CKD.[10,11] .Deficiency of vitamin B12, iron, and folic acid are consequences of dietary insufficiency or blood loss or by decreased erythrocytes' life span are responsible for derangement in RBCs indices.[12, 13] Similarly, Kadhim et al showed decreased RBC count in their study similar to the present study but not statistically significant.[15]

In the present study, platelet count was significantly reduced in CKD group. Similar results have been found in various studies.[14] Behera et al. reported decreasing level of total platelet count though it was not statistically significant with progression of kidney disease.[15] In patients with CKD as well as mild to moderate renal insufficiency due to less production of erythropoietin and destruction of red cells lessened the concentration of hemoglobin and hematocrit.[16] Also, erythropoietin enhances the effect of megakaryocyte colony stimulating factors, acetylhydrolase (PAF-AH) and paraoxonase (PON 1). Therefore, impairment in erythropoietin production can reduce platelet count in patients with CKD.[17] In addition to reduced

hemoglobin, CKD is associated with a variety of biochemical abnormalities reflected by changes in serum concentrations of creatinine, urea, calcium, phosphorus, bicarbonate and potassium.[18] The results of present study indicated that patients with CKD had significant increase in the TLC than in normal group. These findings are in accordance with the study done by Singh S and Bhatta S.[10] Due to complement activation induced by neutrophil aggregation and adherence to endothelial surface, patients with CKD showed elevation in TLC which can be reduced after dialysis.[19]

A single serum creatinine level may be used as a measure of kidney function. Due to inability of kidney to clear creatinine through urine excretion, kidney function deteriorates which results in increased levels of creatinine in serum. In this study, the mean level of creatininein patients with CKD (12.4 mg/dL) was significantly elevated than control population (0.74 mg/dL). This result agreed with the other studies.[10] The levels of pre-urea increased in CKD group by 8.3 folds. These elevated levels of serum creatinine and urea are probably due to increase, shocking, and gastrointestinal bleeding.[20]

In the present study, CKD group observed with significant reduction in sodium levelscompared with healthy group. In contrast, previous study reported insignificant reduction in sodium levels.[21] Sodium is generally retained, but may appear normal, or hyponatremic, because of dilution from fluid retention. Estimation of electrolytes should be performed regularly in patients with CKD to evade delay in correction of dysnatremias which might be responsible for serious complications and further increase the mortality and morbidity rate in patients with CKD.[22] Elevation in potassium (hyperkalemia) and phosphorus (hyperphosphatemia) in CKD can be life threatening. In this study, mean value of potassium and phosphorus are significantly increased in CKD group compared to control group. Development of hypervolemia, hyperkalemia, hyperphosphatemia, hypocalcemia, and metabolic acidosis are more evident in patients with acute or chronic renal failure.[23]

The present study was limited by small sample size. This was a prospective study from a single institution. Further cross-sectional trials with a larger sample size and longer follow up are needed to confirm these findings.

In conclusion, patients with CKD showed a specific profile of biochemical and hematological parameters. A good understanding of the differences in our cohort with those in the general population might aid in the clinical follow-up of patients with CKD.

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