

HEMATOLOGICAL PROFILE AND SERUM POTASSIUM LEVEL IN PATIENTS OF CHRONIC RENAL FAILURE AT A TERTIARY HEALTH CARE CENTER

Yogi Jai P¹, Fiza Bushra², Godara Suraj³, Sinha Maheep⁴

¹Demonstrator, ² Professor, ⁴Professor, and Head, Department of Biochemistry, Mahatma Gandhi Medical College & Hospital, Jaipur, Rajasthan, India.

³Professor and Head, Department of Nephrology, Mahatma Gandhi Medical College & Hospital, Jaipur, Rajasthan, India.

ABSTRACT

Background: Chronic Kidney Disease (CKD) can be defined as an estimated glomerular Filtration Rate (eGFR) of less than 60 ml/min/1.73 m² for a minimum period of three months. CKD is commonly associated with various hematological abnormalities especially anemia. **Aim:** The present study was planned to assess the hematological variations in CKD patients as compared to healthy subjects. **Method:** Fifty patients diagnosed with CKD were enrolled for the study. Fifty age and sex-matched healthy subjects constituted the control group. Blood samples were collected for all subjects enrolled in the study and subjected to analysis including complete blood count (CBC) using five parts cell counter and renal function test (RFT), including urea, creatinine using dry chemistry, and potassium using direct ion-selective electrode method. **Result:** On comparison of the hematological profile, it was observed that all enrolled CKD patients were anemic with hemoglobin (Hb) less than 13g/dL in males and less than 12 g/dL in females. The mean Hb levels were as low as 7.50 ± 1.55 g/dL (P< 0.0001). Correspondingly, total RBC count of CKD patients was also low. It was also observed that platelet count was slightly low among CKD patients. However, the mean level was comparable with control group (P=NS). On further analysis, it was observed that among fifty CKD patients, 46% (n=23) suffered from severe anemia i.e. Hb < 7 gm/dL, whereas 48% had moderate anemia i.e. Hb between 7-9.9 gm/dL. However, only 12 % (n=6) CKD patients suffered from thrombocytopenia i.e. platelets count < 1.50 lack/cmm. **Conclusion:** Hematological abnormalities may lead to several associated morbidities and may pose a challenge for maintenance of overall health status for CKD patients. Hence, there is need to monitor hematological profile of CKD patients specially those on dialysis so that any abnormality can be detected and managed accordingly.

Keywords: Chronic kidney disease; Anemia; Hematological changes; Potassium; Platelets.

INTRODUCTION

Chronic kidney disease (CKD) is defined as kidney damage or estimated glomerular filtration rate (eGFR) of less than 60 ml/min/1.73 m² for a period of 3 months or more [1]. End-Stage Renal Disease (ESRD) is the final stage of CKD characterized by progressive, irreversible deterioration in renal function resulting in fluid and electrolyte imbalance. This leads to uremia. ESRD is characterized by a decrease in GFR and evidence of less than 10% nephron function remaining [2].

CKD is associated with a variety of hematological abnormalities. Anemia is the most common, consistent and severe of the various hematological abnormalities [3]. According to the NKF/KDOQI guidelines (2002), anemia in Chronic Kidney Disease can be defined as hemoglobin level less than 13.0 g/dl in adult males and less than 12.0g/dl in adult females [4].

The primary cause of anemia in CKD patients is insufficient production of erythropoietin. Other factors include deficiency of iron, folate & B12, probably due to increased blood loss or nutritional insufficiency [5]. Other causes may consist of acute and chronic inflammation with impaired iron utilization, severe hyperparathyroidism (HPT) and reduced red cell life span due to uremia [5, 6].

Prolonged anemia, if untreated, may lead to several physiologic disorders. The significant complications anticipated are; cardiovascular manifestations like decreased tissue oxygenation increased cardiac output, ventricular dilatation and ventricular hypertrophy, and ultimately increased mortality and morbidity. Renal insufficiency is also associated with bleeding tendency attributed to platelet dysfunction [5].

Besides genetic and pathological factors, certain environmental factors may also be responsible for development of renal insufficiency. Presently, the number of studies on hematological derangements in CKD patients is quite less, especially among the Indian population [7].

The present study was planned to evaluate the hematological profile of CKD patients and its



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Correspondence: Bushra Fiza, Department of Biochemistry, Mahatma Gandhi Medical College & Hospital, Jaipur, Rajasthan (India). Email: bushrafiza786@gmail.com

comparison with healthy control group at a tertiary care center located in the state of Rajasthan.

MATERIAL AND METHODOLOGY

Study design: Case-control analytical study

Ethics approval: The study was conducted after seeking approval from the Institutional Ethics Committee and informed consent was obtained from all participants.

Sample size: Fifty patients diagnosed for end-stage renal disease (ESRD),

Study population & place: ESRD patients visiting the outpatient department of Nephrology at Mahatma Gandhi Medical College & Hospital, Jaipur

Inclusion criteria: Fifty diagnosed cases of CKD (stage 4 and 5) as per the guidelines of National Kidney Foundation [4], age up to 60 years. Fifty age and sex-matched healthy subjects constituted the control group. According to the above criteria, Stage 4 CKD is defined as GFR 15 – 29 ml/min/1.73 m² and Stage 5 CKD is < 15 ml/min/1.73 m².

Exclusion criteria: Patients suffering from primary hyperparathyroidism or Vitamin D supplementation, who underwent thyroid or parathyroid surgeries, were also excluded.

Methodology: Blood samples were collected for all subjects enrolled in the study and subjected to analysis for renal function test (RFT) including serum urea, creatinine, potassium using dry chemistry and direct ion-selective electrode method on VITROS 5600 and hematological profile including total leucocyte count (TLC), hemoglobin (Hb), platelets count and red blood cell (RBC) count.

Statistical analysis: Results obtained were analyzed using a statistical package program (SPSS 17 Inc; Chicago II, USA) for social science. All variables were presented in the two groups as mean ± SD and compared by applying Student’s t-test.

RESULTS

On the evaluation of distribution of co-morbid conditions in CKD patients, the study reported hypertension as the most common co-morbid condition associated with CKD. Out of fifty CKD patients, 29 (58%) patients had hypertension, and 4 (8%) had Diabetes mellitus. 14 patients (28%) patients had both hypertension and diabetes mellitus while 3 (6%) patients suffered from other comorbidities (Fig 1).

Parameters evaluated in the study and control group are presented in (Table1). The mean Hb level of CKD group was as low as 7.50+/- 1.6g/dL. Mean RBC levels were significantly lower (P < 0.0001) lower in CKD patients (3.03± 0.60) as compared to healthy subjects (5.07±0.54). Comparison of Platelets was not considerably (221.52± 83) in CKD group as compared to healthy subjects (247.73±64.80). The mean serum

potassium levels were significantly higher in CKD population as compared to age-matched healthy subjects with normal kidney function (Table 1).

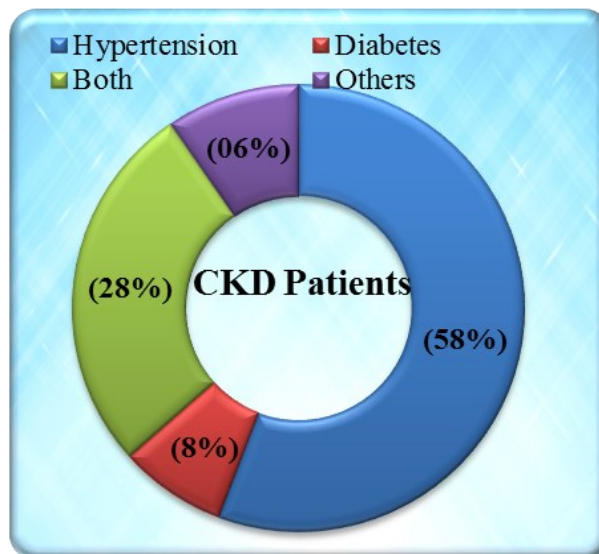


Fig 1. Distribution of the CKD patients based on Comorbid Conditions

Table 1: Distribution of variables between CKD patients and Control group

Variables	CKD patients	Control	t-value	P-value
Age (years)	38.98±10.3	38.3±13.7	0.29	NS
Haemoglobin (g/dL)	7.50±1.6	14.7±1.4	-24.02	0.000
RBC (10 ⁶ /mm ³)	3.03±0.6	5.1±0.5	-17.87	0.000
Platelets (10 ³ /uL)	221.52±83	247.7±65	-1.76	0.081
Sr. Potassium (mmol/L)	5.98±0.7	4.23±0.5	14.62	0.000

Table 2: CKD Patients grouped according to severity of anemia [8].

Type of anemia	No. of cases (%)
Mild anemia (10-11.9gm %)	3 (6)
Moderate anemia (7-9.9gm %)	24 (48)
Severe anemia (<7gm %)	23 (46)
Platelet count	
Thrombocytopenia(< 1.5 lakhs/cmm)	6 (12)
Normal (1.5to 4.5 lakhs/cmm)	42 (84)
Thrombocytosis (> 4.50 lakhs/cmm)	2 (4)

Thrombocytopenia (platelet count < 1.50 lakhs/cmm) was present in 12% of patients, while thrombocytosis (platelet count > 4.50 lakhs/cmm) was present in only 4% of the total patients.

DISCUSSION

The mean age of CKD patients (38.98 ± 10.32) was comparable with that of healthy control group. However, out of 50 CKD patients, maximum number $n=16$ (32%) patients were in the group of 51-60 years, which is similar to the study done by Ann M *et al.* [7].

The significant comorbidities identified among the CKD patients were diabetes and hypertension. The observations are similar to the studies carried out by Chhetri PK *et al.* 2009[9] and Dash SC *et al.* 2006[10] where diabetes mellitus and hypertension were identified as leading causes. Coresh J *et al.* 2007[11] also reported that two leading causes of CKD, i.e. hypertension and diabetes, account for as much as 70% of all new cases.

Healthy kidneys produce a hormone called erythropoietin (EPO). EPO prompts the bone marrow to make red blood cells, which then carry oxygen throughout the body [12].

Anemia of chronic renal failure is multifactorial. The pathogenesis of this type of anemia has been attributed to decreased plasma erythropoietin due to renal damage, inhibitors of erythropoiesis in uremic plasma, and decreased hemoglobin oxygen affinity [13]. In addition to damage to renal site of erythropoietin production, plasma erythropoietin and erythropoiesis are further suppressed in patients with renal disease. The stimulus to erythropoietin production is less intense than in patients with comparable severe anemia due to other causes. This is because the affinity of oxygen decreases, which increases the availability of oxygen per unit of hemoglobin circulating through the kidney [13].

This finding was in concordance with the studies by Bhatta S *et al.* [14], Barde R *et al.* [15], Hakim *et al.* [12], and Bhattacharjee K *et al.* [16]. The prevalence of mild, moderate and severe anemia by WHO criteria [6] was 5.26%, 55.26%, and 39.48% respectively.

Usually 90% of the hormone is produced in peritubular interstitial cells of the kidney and 10% in the liver and elsewhere, there are no performed stores and the stimulus to erythropoietin production is then oxygen tension in the tissues of the kidney, erythropoietin production, therefore, increase in anemia, when hemoglobin for some reason is unable to give up oxygen usually, when atmospheric oxygen is low or when destructive cardiac or pulmonary function or damage to the renal circulating affect oxygen delivery to the kidney.

Hakim *et al.* [12] found the mean platelet count among ESRD patients to be significantly reduced (1.75 ± 0.065 lakhs/cmm) compared to controls. Another study by Dorgalaleh *et al.* [17] found the mean platelet count in CKD patients to be 1.72 ± 0.9 lakhs/ cmm and reduced compared to controls. Other studies show platelet dysfunction in many cases of ESRD which predisposes the patients to bleeding [18,19].

CKD and ESRD inevitably lead to K derangements and an increased risk of adverse cardiovascular events and mortality [20]. Potassium (K) is the most abundant intracellular cation with >98% of total body K located intracellularly and <2% extracellularly.

CONCLUSION

This study showed absolute prevalence of anemia in patients of CKD. It was predominantly of the normocytic normochromic type, suggesting EPO deficiency as the primary cause. However, in some cases, the presence of abnormal cells such as fragmented RBCs, pencil cells, and macro-ovalocytes suggest other contributory factors, such as hemolysis, iron deficiency, or folate/vitamin B12 deficiency. Neutrophilic leukocytosis in some patients may be explained by the tendency towards latent or secondary infections. Although the platelet counts, bleeding, and clotting times were mostly normal in this study.

Suggestions: In the light of this study, there is a need for nephrologists to monitor the hematological profile of CKD patients on dialysis, and treat any derangements in the same, to improve outcome for these patients.

Conflict of interest : Nil

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