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Spectrum of red blood cell parameters in chronic kidney disease in a tertiary care centre

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Abstract

Background: Chronic Kidney Disease (CKD) is an emerging public health problem worldwide. The increasing cost of healthcare, particularly in developing nations like India, is a social and economic burden. Slow but progressive deterioration in kidney function leads to numerous hematological and biochemical changes. The aim of the present study is to study various changes in red cell parameters that occur in the CKD patients.

Materials and Method: 50 patients with CKD were included in this study. Age, gender, RBC count; hemoglobin (Hb); hematocrit; mean corpuscular volume (MCV); mean corpuscular hemoglobin (MCH); MCH concentration (MCHC); and peripheral smears were studied. Results were analyzed using SPSS 20.0 version.

Results: Of the 50 CKD patients on maintenance HD, the most common group sampled were male patients (72%) with the mean age of 54 (± 15) years. The study revealed that Hemoglobin (Hb), Packed Cell Volume (PCV), Red Blood Cells (RBC) were low in CKD patients. The most common type of anemia was normocytic normochromic anemia, followed by dimorphic anemia. Fragmented RBCs and Spherocytes were 42% and 32% respectively.

Conclusion: CKD is associated with different degrees of abnormality in hematological parameters that needs careful evaluation and management. From the CBC and peripheral smear findings the type of anemia, the degree of hemolysis can be analysed and the patients can be evaluated for the underlying cause and treated appropriately. The present study might help clinicians understand haematological profile and take necessary steps in the management.

Keywords: Chronic kidney disease, RBC indices, Anemia, erythropoietin

Introduction

The National Kidney Foundation (NKF) in India states, kidney diseases rank 3rd amongst life threatening diseases, next only to cancer and heart disease [1]. Chronic Kidney Disease (CKD) is a pathophysiologic process due to various etiologies, resulting in progressive reduction in nephron number and function, leading to End-Stage Renal Disease (ESRD) [2]. It is known that hematological mainly RBC parameters are deranged in CKD. Anemia is the most common, consistent and severe of the various hematological abnormalities.

The primary cause of anemia is decreased production of Erythropoietin (EPO) by the diseased kidneys. A diminished capacity to excrete potentially toxic metabolic end products may contribute to anemia by shortening the red cell life span, by marrow suppression and by increasing the risk of blood loss. Concomitant inflammatory conditions/ malnutrition may aggravate anemia and impair its response to therapy [3].

Anemia in CKD is usually normocytic normochromic, but sometimes, it can be microcytic hypochromic due to superimposed iron deficiency anemia and hypo proliferative due to reduced EPO activity in the bone marrow [4]. Patients may also show macrocytic anemia due to Vitamin B12/folate deficiency, dialysis-induced changes in red cell volume and bone marrow suppression [5]. Hematocrit is reduced in these patients due to hemodilution.

Usually erythrocytes are normocytic normochromic. Occasionally 'burr' cells are observed along with some triangular, helmet-shaped, or fragmented cells. Other affected hematological parameters in CKD include total leukocytes and its differential counts, platelet count, bleeding time and prothrombin time. White blood cells (WBCs) count, platelet count and bleeding time were within normal ranges in CKD subjects [6]. Other findings reported include eosinophilia and prolonged bleeding time [7]. This study might help clinicians to be aware of various changes RBC parameters and peripheral smear in CKD patients.

Aims and Objectives

- To analyze the changes in various RBC parameters (Hb, hematocrit, RBC count, and RBC indices) and peripheral smear findings in patients with CKD.

Materials and Methods

It is a hospital based cross sectional Study. Patients with CKD at the Department of Nephrology at Sree Mookambika Institute of medical sciences, during the period of January 2020 - August 2020 were included in this study. The selection of patients was based on previous diagnosis with chronic kidney disease, 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].

Inclusion criteria: All the patients suffering from chronic kidney disease and age > 15 years.

Exclusion criteria: Patients with Recent blood transfusion (<3 months) and Patients on drugs affecting haematological parameters like NSAIDS, antihistamine and aspirin. Haematological investigations which includes Hb, PCV,

RBC count, MCV, MCH and MCHC were done on a standardized, quality controlled and maintained automated cell counter 6- parts YUMIZEN H550. Peripheral smears were prepared in all the samples and Leishman's staining was done. The haematological data were entered in MS-Excel spread sheet and the statistical analysis was performed by SPSS 20.0 version.

Results

In this study, a total of 50 CKD patients participated. The following results were obtained. The age of the patients were between 17 to 78 years with the mean age of 54 years. Among 50 cases 36 (72%) were males and 14 (28%) were females.

Table 1: Mean score RBC, Hb, PCV, MCV, MCH, MCHC

Parameters	Mean
RBC (million cells/mm ³)	2.85±0.66
Hb (gm/dl)	8.45 (2.30)
PCV (%)	25.35 (6.82)
MCV (fL)	91.22±6.48
MCH (pg)	31.12±4.64
MCHC (gm/dl)	33.37±1.07

Table 2: Comparison of mean red blood cell count, hemoglobin, and packed cell volume in chronic kidney disease

Mean values	Present study	Suresh <i>et al.</i> [9]	Talwar <i>et al.</i> [10]	Wasti <i>et al.</i> [11]	Singh <i>et al.</i> [12]	Shittu <i>et al.</i> [13]	Alghythan and Alsaeed [14]
RBC count × 10 ⁶ /μl	2.85	3.06	2.54	3.3	-	2.82	4.13
Hb%	8.45	8.83	7.1	9.2	7.27	7.6	11.7
PCV %	25.35	27.13	-	28	21.4	27.13	35.14

Table 3: Type of Anemia in Peripheral smear

Morphological parameters	Frequency	Percentage
Normocytic normochromic anemia	35	70
Normocytic hypochromic anemia	1	2
Microcytic hypochromic anemia	1	2
Microcytic normochromic anemia	1	2
Dimorphic anemia	8	16
Normocytic normochromic blood picture	4	8

The RBC count, Hemoglobin concentration and Hematocrit is decreased in chronic renal failure patients, which is statistically significant (P= 0.0001). More than 70% of patients had normal MCV, MCH, and MCHC values. The most frequent peripheral smear picture seen predominantly was normocytic normochromic anemia (70%), followed by dimorphic anemia in 16% of cases.

Discussion

The hematological changes in 50 CKD patients were studied. The results showed various degrees of changes in hematological parameters. In our study, it has been observed that the RBC count is decreased in chronic renal failures. Primary cause of decrease RBC count in chronic renal failure is impaired erythropoietin production and other factors which suppress marrow erythropoiesis and shortened red cell survival. Erythropoietin is the hormone which is the major humoral regulator of red cell production and helps to maintain the viability of RBC by retarding the cleavage of DNA that occurs normally in CFU-Es. Hematocrit is also decreased in chronic renal failure patients. Hematocrit generally provide an accurate reflection of the extent to which the circulating red cell mass is reduced. In chronic renal disease because of impaired

erythropoietin secretion, increased destruction of red blood cells, leads to a fall in red blood cell count, which reduces the hemoglobin concentration and hematocrit [15]. A decrease in hematocrit is apparent even among patients with mild to moderate renal insufficiency. These findings also agree with the studies conducted by Alghythan *et al.*, [14]. Gautham *et al.*, [16], Suresh *et al.*, [9] Talwar *et al.*, [10] and Singh *et al.*, [12] which showed low RBC counts and hematocrit values associated with CKD patients.

Out of 50 CKD patients 47 (94%) had anemia and 3(6%) had normal Hb. Moderate anemia was the most common (64%). Severe anemia was noticed in 22% patients. The mean Hb value was 8.58±1. This study showed similar results obtained in the study done by Suresh *et al.* [9] Talwar *et al.*, [10] Shittu *et al.*, [13] Seuga *et al.* [17], Mohd Ali MS *et al.* [18], Alghythan AK *et al.* [14] and Gautham *et al.* [16]. In progressive renal insufficiency, the degree of anemia is generally proportional to the severity of azotemia. Bhatta S *et al.* in their study also showed moderate anemia in majority of the CKD cases [19].

Majority of patients (>70%) with CKD in our study population showed normal MCV, MCH, and MCHC values. The present study agrees with the studies by Talwar *et al.* [10], Singh *et al.* [12], and Alghythan [14] and Alsaeed, in which majority of patients showed normal RBC indices. Like the studies conducted by Suegak *et al.* [17], Pandian *et al.* [20], Gautham *et al.* [16], the peripheral smears studied revealed that the most common type of anemia was normocytic normochromic anemia. This is in contrast to Bhatta S *et al.* and Kaze FF [21] studies which showed microcytic hypochromic anemia most common. In our study following normocytic normochromic anemia, dimorphic anemia is second common type of anemia noticed.

Microcytic hypochromic anemia and macrocytic normochromic anemia was noticed in 2% of the patients. Macrocytosis was higher in these patients, which was similar to the study conducted by Afshar *et al.* [22]. The possible causes are loss of water soluble B12 and folate during HD.

Fragmented RBCs (Fig: 1) and spherocytes (Fig: 2) were 42% and 32% respectively. Helmet cells resulted due to trauma in diseased renal vasculature, thereby resulting in extra corpuscular fragmentation haemolytic anemia [23], it was also demonstrated in studies done by Dacie and Brain *et al.* Features of hemolysis were predominantly seen in patients with Stage 5 CKD and few with Stage 4 disease

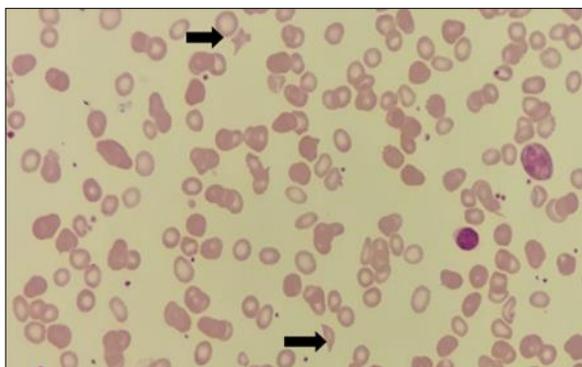


Fig 1: Fragmented RBCs



Fig 2: Spherocytosis

Summary

Chronic kidney disease (CKD) is a progressive disease that results in significant morbidity and mortality. Of the 50 CKD patients the most common group sampled were male patients (72%) with the mean age of the patients around 54 (± 15) years. Hb, PCV, RBC was decreased. Majority of the CKD patients had normal MCV, MCH and MCHC. The most common type of anemia was normocytic normochromic, followed by dimorphic anemia. Fragmented RBCs and spherocytes were 42% and 32% respectively. Macrocytosis and hypersegmented neutrophils were also seen. Recommended that vitamin B12 level and folate assay may be done. Microcytic hypochromic anemia though second most common type of anemia in CKD patients, in this study, only 2% of the patients had microcytic hypochromic anemia which may be due to the iron and EPO supplementation given to all CKD patients. Various therapeutic options available for the anemia of CKD include red blood cell transfusions, treatment of underlying cause and use of erythropoietin.

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