



Original Article

Anemia in chronic kidney disease patients in predialysis and postdialysis stages

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ABSTRACT

Background: Chronic kidney disease is usually associated with anemia and the level of anemia correlates with the severity of renal failure. This study was carried out to evaluate the profile of anemia and to find the correlation between the severity of anemia and serum creatinine levels in predialysis and postdialysis Chronic kidney disease patients.

Materials and Methods: A cross-sectional study was conducted in 40 chronic kidney disease patients in the department of pathology and nephrology, KIST Medical College. Hemoglobin, hematocrit, red cell indices, peripheral blood smears and serum creatinine levels were examined using standard techniques.

Results: There was a significant difference in the hemoglobin and hematocrit levels in predialysis and postdialysis patients ($P < 0.005$). All 40 patients (100%) were anemic. Although moderate anemia was most common in both groups of patients, severe anemia was more common in postdialysis patients (5% in predialysis and 15% in postdialysis patients). The peripheral blood smear examinations showed that normocytic normochromic anemia was most frequent (90% in predialysis and 77.5% in postdialysis patients). There was no significant correlation between the severity of anemia and serum creatinine levels ($P > 0.05$), $r = -0.14$ and -0.17 in predialysis and postdialysis group respectively.

Conclusion: The most frequent anemia in chronic kidney disease patients was normocytic and normochromic type of a moderate degree. Significant correlation was not found between the severity of anemia and serum creatinine levels in both pre and postdialysis group of patients.

INTRODUCTION

Anemia is defined in terms of low levels of hematocrit (Hct) or hemoglobin (Hb).¹ It is a common sequelae of chronic kidney disease (CKD), associated with significant morbidity. Anemia of renal failure begins relatively early

in the development of kidney disease. As the destruction of the kidney progresses, the degree of anemia increases. Although, there is a large degree of patient to patient variability, the Hct generally begins to fall when the plasma creatinine concentration is above 2 mg/dl and gets lower as glomerular filtration rate (GFR) declines.¹⁻³

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Anemia of CKD is a complex disorder determined by a variety of factors. Although, the primary defect is decreased erythropoiesis due to inadequate erythropoietin (EPO) production from the kidneys, a number of other factors

may play contributory roles. The factors are shortened erythrocyte survival, blood loss, iron and other nutritional deficiency, aluminium toxicity and the effect of uremic inhibitors on the bone marrow. Severe hyperparathyroidism is one cause of anemia in CKD patients. Non-renal and non-dialysis factors can also superimpose themselves on the anemia of chronic renal failure. These include drug induced bleeding, infection and inflammation.^{1,4-7}

A normocytic normochromic red blood cell is common complication of CKD. A microcytic and hypochromic blood picture suggests either iron deficiency or aluminium intoxication. Macrocytic anemia is usually due to folate and B12 deficiency. Both types of anemia can occur in CKD patients.³ The aim of this study was to determine the profile of anemia and to correlate the severity of anemia with serum creatinine (SC) levels in pre and postdialysis CKD patients.

MATERIALS AND METHODS

The study was carried out at KIST Medical College, Department of Pathology and Nephrology over a period of 6 months (June to November 2010). The study consisted of 40 pre and postdialysis CKD patients.

Inclusion criteria:

1. Patients providing informed consent.
2. Patients with documented chronic kidney disease.

Exclusion criteria:

1. Acute or chronic inflammatory disease.
2. Malignancy or known hematological disorder.
3. Recent severe hemorrhagic episode.

Data including age, gender and CKD causes were collected

in a questionnaire. Venous blood samples were obtained from patients before dialysis and after completion of dialysis. Hb, Hct and Red cell indices were calculated using the Coulter Counter Huma Count 30TS. Wright stained peripheral blood smears were studied for red blood cell morphology. SC levels were determined using the semiautomated analyzer Stat Fax 3300.

The 2006 National Kidney Foundation [Kidney Dialysis Outcomes Quality Initiative (KDOQI)] Guidelines for CKD anemia (Hb level < 13.5 g/dl in males and < 12 g/dl in females) were used.⁸ In our study, the severity of anemia was graded as mild (Hb > 10 g/dL), moderate (Hb = 7-10 g/dL) and severe (Hb < 7 g/dL).

All data analyses were carried out using the Statistical Package for Social Science (SPSS, version 17) for Windows. Paired t-test, linear regression and correlation analysis were used to do the statistical analyses. P-value < 0.05 was considered as statistically significant.

RESULTS

Of the 40 CKD patients, 25 (62.5%) were male and 15 (37.5%) were female. The age of the patients ranged from 20-83 years with mean age being 45.9±17.98 years. The most frequent causes of CKD was hypertension 25 (62.5%) followed by a combination of hypertension and diabetes mellitus 10 (25%), chronic glomerulonephritis 3 (7.5%) and polycystic kidney disease 2 (5%).

The Hb levels in predialysis patients ranged from 5 g/dl to 12 g/dl, with a mean of 9.34 ±1.67 g/dl where as in postdialysis patients the range was 4.5 g/dl to 11 g/dl with a mean of 8.2±1.47 g/dl. The Hct levels in the predialysis group ranged from 16-38%, with a mean of 28.2 ±5.03%. In postdialysis patients the Hct ranged from 14-34% with a

Table 1: The morphology of anemia in predialytic and postdialytic patients

Morphology	Predialysis			Postdialysis		
	Male	Female	Total	Male	Female	Total
Normocytic normochromic	24	12	36 (90%)	21	10	31 (77.5%)
Microcytic hypochromic	0	3	3 (7.5%)	2	4	6 (15%)
Macrocytic normochromic	1	0	1 (2.5%)	2	1	3 (7.5%)
Total	25 (62.5%)	15 (37.5%)	40 (100%)	25 (62.5%)	15 (37.5%)	40 (100%)

Table 2: The severity of anemia in predialytic and postdialytic patients

Severity of anemia	Predialysis			Postdialysis		
	Male	Female	Total	Male	Female	Total
Mild	12	6	18 (45%)	4	0	4 (10%)
Moderate	11	9	20 (50%)	15	15	30 (75%)
Severe	2	0	2 (5%)	6	0	6 (15%)
Total	25 (62.5%)	15 (37.5%)	40 (100%)	25 (62.5%)	15 (37.5%)	40 (100%)

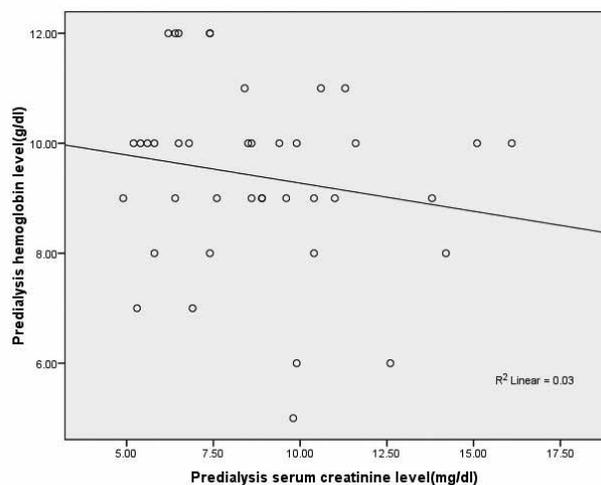


Figure 1. The Correlation Between Predialysis Hemoglobin and Serum Creatinine Levels.

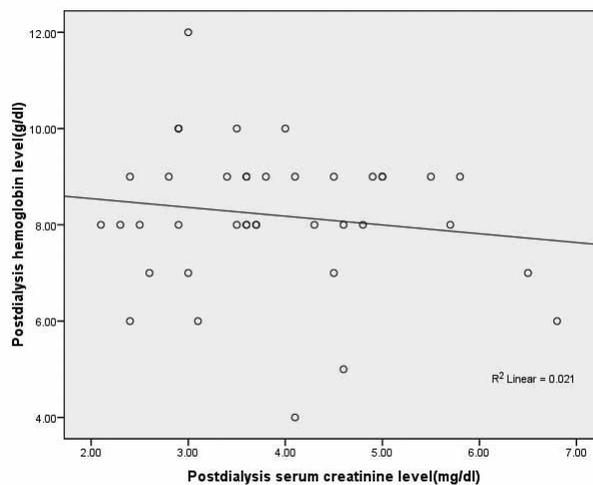


Figure 2. The Correlation Between Postdialysis Hemoglobin and Serum Creatinine Levels.

mean of $24.6 \pm 4.41\%$. There was a significant difference in the Hb and Hct levels between postdialysis and predialysis patients ($P < 0.001$). The prevalence of anemia was 100% in both pre and postdialysis patients.

Normocytic and normochromic anemia was predominant in both pre and postdialysis patients. In postdialysis patients, microcytic hypochromic and macrocytic normochromic anemia was higher than in predialysis patients (15% and 7.5% respectively). (Table 1). The severity of anemia in pre and postdialysis patients is shown in Table 2.

The relationship between Hb and SC levels was determined using linear regression and correlation. The correlation between Hb and SC levels was not significant in both the pre and postdialysis groups ($P > 0.05$), $r = -0.14$ and -0.17 . (fig. 1 and 2)

DICUSSION

Anemia is a common complication of CKD. In 25 (62.5%) of the patients we found hypertension to be the most frequent cause of CKD. In other studies diabetes mellitus was the most frequent cause of CKD followed by hypertension.⁹ Anemia in CKD is evident when a patient's creatinine clearance (CC) is less than 30 ml/min/1.73m², GFR is below 50-40 ml/min, or SC is more than 3 mg/dl. If the GFR is less than 20 ml/min or the SC is more than 5, anemia is always present and the Hb level is below 10 g/dl.¹⁻³ In this study, anemia was present in 100% of pre and postdialysis patients. In another study the prevalence of anemia was 100% in postdialysis patients and 73.1% in predialysis patients.¹¹ Reza Afshar et al⁹ found anemia in 85% of postdialysis patients and 75% of predialysis patients. The lower the GFR or EPO production, the greater the loss of hematopoietic nutrient elements. Inflammation caused by the dialytic membrane can lead to lower mean Hb and Hct levels in dialysis patients.¹² Our study showed a significant

difference between Hb and Hct levels in pre and postdialysis patients which is similar to the study done by Seuga et al.¹¹

The degree of anemia increases as progressive destruction of kidney tissue occurs. This study, like others, revealed presence of a predominantly moderate degree of anemia in pre and postdialysis patients.^{9,11} Severe anemia was present in 15% of postdialysis patients and 5% of predialysis patients. The most frequent morphological feature of anemia was normocytic and normochromic type followed by microcytic and hypochromic anemia. This was similar to the findings in other studies.^{9,11,13} Microcytic hypochromic anemia has different causes, but the most common is iron deficiency particularly due to a decrease iron intake or an increase in iron loss.¹⁴ Macrocytosis in postdialysis patients was higher than in predialysis patients. The possible causes are loss of water soluble B12 and folate during hemodialysis.

In progressive renal insufficiency, the degree of anemia is generally proportional to the severity of azotemia.¹⁵ In one study, the Hb concentration was positively correlated with the estimated CC ($p < 0.001$).⁹ Another study revealed a negative correlation between Hb and SC levels.¹¹ There was no significant correlation between the severity of anemia and SC levels in our study.

CONCLUSION

Our study showed that the most common type of anemia in CKD patients is normochromic and normocytic type. A moderate degree of anemia is the most frequent finding in pre and postdialysis patients. There was a significant difference between Hb and Hct levels in pre and postdialysis patients. There was no significant correlation between Hb and SC levels. Further evaluation of iron and vitamin profiles in CKD patients will help establish the causes of anemia in the future.

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