

Changes in Hematological Indices in Different Stages of Chronic Renal Failure

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The study was carried out to observe some aspects of hematological changes like Hb concentration, PCV and TC of RBC in different stages of Chronic Renal Failure (CRF) patients suffering from anemia. For this purpose, 65 male CRF patients with anemia and 25 apparently healthy male (control) subjects of age ranged from 30-50 years were selected randomly from BSMMU out patient department. Hematological parameters and renal creatinine clearance were estimated by usual laboratory technique. Data were analyzed statistically by ANOVA and Pearson's correlation coefficient test. Among the CRF patients 15 were mild, 25 were moderate and 25 were severe CRF patients with anemia. In this study, the mean Hb concentration, PCV and total count of red blood cells were significantly lower in three stages of CRF patients with anemia compared to those of healthy subjects. Again, all of these hematological values were significantly ($P < 0.001$) lower in moderate and severe CRF patients compared to mild cases and also in severe cases than those of moderate CRF cases with anemia. All the Hematological parameters showed positive correlation with creatinine clearance in all three stages of CRF and it was statistically significant in moderate and severe group. From the present study it may be concluded that CRF patients with anemia had lower hematological indices and the degree of changes depend on severity of renal failure.

Key Words: Hemoglobin; Packed Cell Volume; Renal Failure

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Introduction

Chronic renal failure (CRF) is one of the major health problem throughout the world¹. In Bangladesh, 5% of total population have been suffering from renal diseases. Among them, about 15,000 to 20,000 patients are dying of CRF in each year². Anemia is one of the consistent and severe hematological complication in this group of population³. Occurrence of anemia in the course of the disease process is well established⁴. Again, it has also been reported that the severity of anemia increases along with the severity of disease³. Currently available data showed that CRF patients associated with anemia has a public health importance in developing countries⁵. CRF is associated with higher level of serum creatinine

along with lower creatinine clearance and according to these values the disease can be categorized in to mild, moderate and severe one⁶.

Extensive studies on hematological parameters related to anemia, like hemoglobin concentration, packed cell volume and total count of red blood cell in different stages of CRF patients have shown that all these values were gradually lowered with the severity of disease^{1,5,7}. This effect though started in mild cases but was more marked in severe CRF patients⁸.

In our country, a major number of kidney patients are suffering from CRF associated with anemia². Anemia is an independent risk factor for the development of cardiac dysfunction like increased cardiac output, cardiac enlargement,

left ventricular hypertrophy and congestive cardiac failure. It may decrease the quality of life and exercising capacity⁸. Cardiovascular diseases account for 40 to 50% of all deaths in the CRF patients. Mortality rate in this group of patients are 15- times higher than that of general population⁹. Though various observations have been reported from different countries but no such study have yet been reported in our country regarding hematological changes in CRF patients along with the severity of disease. Therefore, the present study was designed to observe some aspects of hematological changes in different stages of CRF.

Methods

The study was carried out to observe the hematological indices in patients with different stages of CRF. For this, 65 male CRF patients with anemia and 25 healthy male (control) subjects of age ranged from 30-50 years were selected randomly. Among CRF patients 15 mild, 25 moderate and 25 were severe cases. The diagnosed CRF patients were taken from the out patient department of Nephrology, BSMMU, who fulfill the inclusion criteria- CRF patients with anemia having hemoglobin concentration < 12gm / dl and Ccr30-50ml/min, Ccr16-29ml/min, Ccr5- 15ml/min respectively used to classify CRF patients with anemia into mild, moderate, severe CRF patients^{6,8}. Apparently healthy subjects were selected from the kidney donors

attending out patient department of nephrology, BSMMU. CRF patients with history of kidney transplantation, liver disease, nonrenal origin of anemia (previous history of GIT bleeding, malignancy, chronic TB), history of erythropoietin therapy and history of blood transfusion during last three months¹⁰⁻¹² were excluded from the study.

After selection of the subjects, objectives and procedure of the study were explained and then verbal consent was obtained from the patient. Blood and urine samples were taken from each subject for measurement of hematological parameters and creatinine clearance test. Required volume of blood was transferred into a dry test-tube containing Paul Heller mixture for determination of PCV and adequate amount of blood was taken into a glass test tube for measurement of hemoglobin concentration and total count of RBC. From the rest of the blood serum was collected for measurement of serum creatinine. A labeled plastic container was supplied to each of the study subject for collection of 24hours urine and from that creatinine clearance value was measured. Statistical analysis was done by ANOVA and Pearson's correlation coefficient tests.

Results

The mean (\pm SD) Hb concentration, PCV and TC of RBC in control and CRF patients with different stages was shown in (Table-I).

Table-I : Hemoglobin concentration, Packed cell volume, Total count of red blood cell in different stages of CRF patients with anemia and in healthy subjects.(n=95)

| Groups | n | Hemoglobin (g/dl) | Packed cell volume(%) | TC of RBC(million/ml) |
|--------------|----|------------------------------------|------------------------------------|--------------------------------|
| | | Mean (\pm SD) | Mean (\pm SD) | Mean (\pm SD) |
| Control | 25 | 14 \pm 0.99 (12.51-15.76) | 43.51 \pm 3.44 (38.00-49.00) | 4.98 \pm 0.28 (4.30-5.20) |
| Mild CRF | 15 | 10.85 \pm 0.65 (9.80- 11.77) | 33.17 \pm 2.30 (29.50-37.00) | 3.87 \pm 0.28 (3.44-4.30) |
| Moderate CRF | 25 | 9.13 \pm 0.78 (7.50-10.57) | 28.03 \pm 2.43 (23.00-32.80) | 3.29 \pm 0.33 (2.61-4.00) |
| Severe CRF | 25 | 7.39 \pm 1.01 (6.20- 9.50) | 22.85 \pm 2.57 (20.00-30.00) | 2.79 \pm 0.30 (2.23-3.30) |

Control = Healthy subjects ; CRF = Chronic renal failure ; results are expressed as (\pm SD) ; figures in parenthesis indicate range; n = Number of subjects.

Table – II: Pearson's correlation coefficient of Hb%, PCV and total count of red blood cells with creatinine clearance in different stages of CRF with anemia.(n=65)

| Variables | Stages of CRF | | | | | |
|-----------|------------------|----------------------|----------------------|---------|--------------------|---------|
| | Mild (n = 15) | | Moderate (n = 25) | | Severe (n = 25) | |
| | r | p | r | p | r | p |
| Hb% | 0.298 | > 0.10 ^{NS} | 0.81 | < 0.001 | 0.781 | < 0.001 |
| PCV | 0.386 | >0.10 ^{NS} | 0.823 | <0.001 | 0.797 | < 0.001 |
| TC of RBC | 0.303 | >0.10 ^{NS} | 0.411 | <0.05 | 0.817 | < 0.001 |

N= Number of subjects; CRF= Chronic renal failure; Hb%= Hemoglobin concentration in percentage; PCV= Packed cell volume; TC of RBC=Total count of red blood cell; NS= Not significant.

The Hb concentration, PCV and TC of RBC were significantly lower ($P < 0.001$) in mild, moderate and severe CRF patients compared to those of healthy subjects. Again these concentration were also significantly lower ($P < 0.001$) in severe CRF than those of mild, moderate and also in moderate than those of mild CRF patients.

Correlation-coefficient of Creatinine clearance, with hemoglobin concentration, PCV, total count of RBC in mild, moderate, severe CRF patients with anemia are presented in Table-II.

Values of creatinine clearance rate with Hb concentration, PCV and TC of RBC were positively correlated. All these relationships were statistically significant ($P < 0.001$) in moderate and severe cases but not in mild CRF patients.

Discussion

The mean hemoglobin concentration, PCV and TC of RBC were significantly ($P < 0.001$) lower in mild, moderate and severe CRF with anemia compared to those of healthy subjects. Similar findings were also observed by investigators of different countries^{1,5,9,10}. Again, mean hemoglobin concentration, PCV and TC of RBC were significantly ($P < 0.001$) lower in moderate and severe than those of mild CRF. Again these values were significantly lower in severe than

those of moderate stages. Workers of different countries also made similar observations⁹⁻¹⁵.

The relationships between these parameters with creatinine clearance in both moderate and severe CRF patients were statistically significant ($P < 0.001$). This correlation coefficient of creatinine clearance was statistically significant with Hb concentration and PCV ($P < 0.001$) and also with TC of RBC ($P < 0.05$) in moderate CRF patients with anemia. Some investigators also observed similar findings between PCV and creatinine clearance in CRF patients^{12,16}. Again some other group of investigators found a similar correlation of Hb concentration with creatinine clearance in different stages of CRF⁹. It has been suggested that these hematological changes in patients suffering from CRF might be related to degree of erythropoietin deficiency^{5,8,10}. As anorexia, nausea and vomiting are the common features of CRF patients, less dietary intake of nutrients needed for erythropoiesis might also be a factor for anemia in this group of patients. Moreover, CRF patients are on protein restricted diet which might also have some role for occurrence of anemia in these series of patients³. In this study, the hematological values, i.e. Hemoglobin concentration, packed cell volume and total count of red blood cells were gradually lowered from mild to moderate and were

markedly lowered in severe CRF patients with anemia. Erythropoietin deficiency is the primary cause of anemia in CRF, and the findings of the study are also in favor of gradual destruction of erythropoietin secreting cells of the kidney, in different stages of CRF though these were not measured. These finding are again supported by positive relationship of these hematological parameters with creatinine clearance, which also indicates gradual impairment of renal function in different stages of CRF. Markedly lowered hemoglobin concentration, PCV and TC of RBC in severe CRF are also likely to be due to less dietary intake, as most of them were suffering from gastrointestinal symptoms, like anorexia, nausea and vomiting. Moreover, maximum restriction of dietary protein usually advised in CRF also play a role for marked changes of all these hematological values in this group of patients. From this type of study, it is difficult to comment on the exact mechanism involved for changes of hematological values in CRF patients. Further study on CRF patients regarding estimation of serum erythropoietin and its relationship with creatinine clearance, examination of bone marrow are needed to find out the precise cause.

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