Chattagram Maa-O-Shishu Hospital Medical College Journal
Volume 12, Issue 2, May 2013

Original Article

Relationship of Hemoglobin, Packed Cell Volume and Total Count of RBC with the Severity of Chronic Renal Failure

Shaheda Khanam[1]
Noorzahan Begum[2]
AMM Ehteshamul Hoque[3]

[1]Department of Physiology, Chattagram Maa-O-Shishu Hospital Medical College, Chittagong, Bangladesh

[2]Department of Physiology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbag, Dhaka, Bangladesh

[3]Department of Nephrology, Chattagram Maa-O-Shishu Hospital Medical College, Chittagong, Bangladesh

***Correspondence to:**

Dr. Shaheda Khanam,
Associate Professor of Physiology, Chattagram Maa-O-Shishu Hospital Medical College,
Chittagong, Bangladesh
E-mail: dr.ehteshamctg@yahoo.com

Abstract

Background: Anemia is one of the most consistent and severe hematological complication in chronic renal failure (CRF) patients. Lowered Hb concentration, packed cell volume (PCV) and total count (TC) of red blood cell (RBC) in such patients and the relation of changes of these values with the severity of renal failure is important to detect anemia earlier.. **Subjects and Methods:** The present study has been designed to observe hemoglobin concentration, PCV and TC of RBC in different stages of CRF patients suffering from anemia. For this purpose, 65 male CRF patients with anemia and 25 healthy male (control) subjects, age ranged from 30–50 years were selected randomly from BSMMU outpatient department. Hb concentration, PCV, TC of RBC and creatinine clearance were estimated by usual laboratory technique. Data were analyzed statistically by ANOVA and Pearson's correlation coefficient test. Among 65 CRF patients, 15 were mild, 25 were moderate and 25 were severe with renal failure associated with anemia. **Results:** In this study, the mean Hb concentration, PCV and total count of RBCs were significantly lower in three stages of CRF patients with anemia compared to those of healthy subjects. Again, 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 three stages of CRF and it was statistically significant in moderate and severe group. **Conclusion:** From the present study it may be concluded that CRF patients with anemia had lower Hb concentration, PCV and TC of RBC and the degree of changes depend on severity of renal failure.

Key words: Anaemia, Chronic renal failure.

INTRODUCTION

In Bangladesh 5% of total population have been suffering from renal diseases, among them 15,000 to 20,000 patients are dying of chronic renal failure (CRF).[1] It is one of the major health problems throughout the world.[2] With the progression of the disease, development of hematological abnormalities are common.[3] Anaemia is one of the most consistent and severe hematological complication in this group of population.[4] It has also been reported that the severity of anaemia increases along with the severity of CRF.[4] In developing countries, CRF associated with anaemia has a public health importance.[5] CRF is associated with high level of serum creatinine along with lower creatinine clearance and according to these

values the disease can be categorized into mild, moderate and severe one.[6] Extensive studies on hematological parameters related to anaemia-like hemoglobin concentration, packed cell volume (PCV) and total count of red blood cell (RBC) in CRF patients have shown that all these values were gradually lowered with the severity of disease.[2,5,7] This lowering effect was observed more marked in severe CRF patients.[8,9,10,11] On the contrary, some investigators observed normal values of all these hematological parameters in some of the patients suffering from mild CRF.[10,12] In our country, a major number of kidney patients are suffering from CRF associated with anaemia.[1] Anaemia is an independent risk factor for the development of cardiac dysfunction and it may decrease the quality of life.[8] Cardiovascular diseases account for 40% to 50% of all deaths in the CRF patients, and mortality rate in this group of patients are 15 times higher than that of general population.[9] Again, more earlier correction of anaemia in CRF may be helpful in preventing the development and subsequent progression of the disease.[13] Though various observations have been reported from different countries no such study have yet been reported in our country regarding relationship of hemoglobin, PCV and total count of RBC changes with the severity of CRF. Therefore, the present study was designed to observe these hematological relationships in different stages of CRF.

MATERIALS AND METHODS

The present study was carried out to observe the hemoglobin concentration, PCV and TC of RBC in patients with different stages of CRF. For this, 65 male CRF patients with anaemia and 25 healthy male (control) subjects age ranged from 30 to 50 years were selected randomly. Among CRF patients 15 mild, 25 moderate and 25 were severe group. The diagnosed CRF patients were taken from the outpatient department of nephrology, BSMMU, who fulfils the inclusion criteria—CRF patients with anaemia hemoglobin concentration <12 gm/dl and Ccr 30–50 ml/min, Ccr 16–29 ml/min, Ccr5–15 ml/min, were respectively mild, moderate and severe CRFpatients[6,8] in experimental group. Apparently, healthy subjects were selected from kidney donor attending outpatient department of nephrology, BSMMU. CRF patients with history of kidney transplantation, associated liver disease, non-renal origin of anaemia (previous history of GIT bleeding, malignancy, chronic TB), history of erythropoietin therapyand history of blood transfusion during last three months[10,11,14] were excluded from the study. After selection of the subjects, objectives and procedures of the study were explained and then verbal consent was obtained from the patient. Blood and urine samples were taken from each study subject for measurement of hemoglobin, PCV, TC of RBC and creatinine clearance. 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 for measurement of hemoglobin concentration and total count of RBC. From the rest of the blood, serum was collected in labeled test tube for measurement of serum creatinine. A labeled plastic container was supplied to each of the study subject for collection of 24-hours urine, and from that creatinine clearance value was measured. Statistical analysis was done by using ANOVA test and relationship between different parameters were done by Pearson's correlation coefficient test.

Table 1: Hemoglobin concentration, PCV, TC of red blood cell in different stages of CRF patients with anaemia and in healthy subjects ($n = 90$)

Groups	n	Hemoglobin (g/dl) Mean (±SD)	Packed cell volume (%) Mean (±SD)	Tc of RBC (million/ml) Mean (±SD)
Control	25	14.56 ± 0.99 (12.51–15.76)	43.51 ± 3.44 (38.00–49.00)	4.98 ± 0.28 (4.30–5.20)
Mild CRF	15	10.85 ± 0.65 (9.80–11.77)	33.17±2.30 (29.50-37.00)	3.87 ± 0.28 (3.44–4.30)
Moderate CRF	25	9.13 ± 0.78 (7.50–10.570	28.03 ± 2.43 (23.00–32.80)	3.29 ± 0.33 (2.61–4.00)
Severe CRF	25	7.39 ± 1.01 (6.20–9.50)	22.85 ± 2.57 (20.00–30.00)	2.79 ± 0.30 (2.23–3.30)

Control = healthy subjects, CRF = chronic renal failure, results are expressed as mean (± SD); figures in parenthesis indicate range; *n*= number of subjects.

RESULTS

The mean (±SD) Hb concentration, PCV and TC of RBC in control and CRF patients with different stages are shown in Table 1.

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 concentrations 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 and TC of RBC in mild, moderate and severe CRF patients with anaemia are presented in Table 2.

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 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 anaemia compared to those of healthy subjects. Investigators of different countries also observed similar lower findings of these values in CRF patients.[2,5,9,10] Again, mean hemoglobin concentration, PCV and TC of RBC were significantly ($P < 0.001$) lower in moderate and severe than those of mild CRF patients. In addition, these values were significantly lower in severe than those of moderate CRF cases. Workers of different countries also made similar observations.[9,10,11,15] The relationship between these parameters with creatinine clearance in both moderate and severe CRF patients were statistically significant ($P < 0.001$). Some investigators observed similar findings between PCV and creatinine clearance in CRF patients.[14,16] Again some other group of investigators found a similar correlation of Hb concentration with creatinine clearance in different stages of CRF.[9] It has been suggested that these hematological changes in patient suffering from CRF might be related to degree of erythropoietin deficiency.[5,8,10,16] 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 anaemia in this group of patients. Moreover, CRF patients are on protein restricted diet which might also have some role for occurrence of anaemia in these series of patients.[4] In this study, the hemoglobin concentration, PCV and total count of RBC were gradually lowered from mild to moderate and were markedly lowered in severe CRF patients with anaemia. Erythropoietin deficiency is the primary cause of anaemia 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 findings are again supported by positive relationship of these hematological parameters (Hb concentration, PCV and TC of RBC) 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 plays a role for marked changes of all these hematological

Table 2: Pearson's correlation coefficient of Hb%, PCV and TC of RBC with creatinine clearance in different stages of CRF with anaemia ($n = 65$)

Variable	Stages of CRF					
	Mild (n = 15)		Moderate (n = 25)		Severe (n = 25)	
Hb%	r	P	r	P	r	P
	+0.298	>0.10^{NS}	+0.810	<0.001	+ 0.781	<0.001
PCV	r	P	r	P	r	P
	+o.386	>0.10^{NS}	+0.823	<0.001	+0.797	< 0.001
TC of RBC	r	P	r	P	r	P
	+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.

values in this group of patients. From this type of study, it is difficult to comment on the exact mechanism involved for changes of these hematological values in CRF patients.

CONCLUSION

From the present study it may be concluded that CRF patients with anaemia had lower hematological values (Hb concentration, PCV and TC of RBC) and the degree of changes depends on severity of renal failure. Further study on CRF patients regarding estimation of serum erythropoietin and its relationship with creatinine clearance are needed to find out the precise cause. .

REFERENCES

1. Rashid HU. Haemodialysis: how to reduce cost. Bangladesh Renal J. 1989;8(2):43–4.
2. Hsu CY, Bates DW, Kuperman GJ, Curhan GC. Relationship between hematocrit and renal function in man and woman. Kidney Int. 2001;59:725–31.
3. Davison AM, Cumming AD, Swainson CP, Turner N. Diseases of the kidney and urinary system. In: Davidson's principles and practice of medicine. 8th ed. London: Harcourt Brace and Company; 1998. 433 p.
4. Sweny P, Farrington K, Moorhead JF. Chronic renal failure. In: The kidney and its disorders. Blackwell Scientific Publications; 1989. pp. 359–69.
5. Hsu CY, Mcculloch CE, Curhan GC. Epidemiology of anemia associated with chronic renal insufficiency among adults in the United States: results from the Third National Health and Nutrition Examination Survey. J Am Soc Nephrol. 2002;13:504–10.
6. Morris PJ. Chronic renal failure. In: Kidney transplantation. 5th ed. Philadelphia: WB Saunders Company; 2001. 32 p.
7. Kazmi WH, Kausz AT, Khan S, Abichandahi R, Ruthazer R, Obrados GT, et al. Anemia an early complication of chronic renal insufficiency. Am J Kidney Dis. 2001;38(4):803–12.
8. Kasiske BL, Chaver B, Rosenberg M, Foley R, Swan S, Fogo A, et al. (editors). Anemia of chronic kidney disease. Am J Kidney Dis. 2001; 37 (Suppl 1): S184–198.
9. Kasiske BL, Chavers B, Rosenberg M, Foley R, Swan S, Fogo A, et al. (editors). Association of level of GFR with anemia. Am J Kidney Dis. 2002;39(Suppl 1): S120–7.
10. Kaye M. The anemia associated with renal disease. J Lab Clin Med. 1978;52:83–100.
11. Loge JP, Lange RD, Moore CV. Characterization of the anemia associated with chronic renal insufficiency. Am J Med. 1978;24:4–18.
12. Astor BC, MunterP, Levin A, Eustace JA, Coresh J. Association of kidney function with anemia. J Arch Intern Med. 2002;162:1401–8.
13. Macdougall IC. How to improve survival in predialysis patients? J Nephron. 2000;85(Suppl 1): S15–22.
14. Haward AD, Moore J, Watch PG, Gouge SF. Analysis of the quantitative relationship between anemia and CRF. Am J Med Sci. 1989;297(5):309–13.
15. Hakim RM, Lazarus MJ. Biochemical parameters in chronic renal failure. Am J Kidney Dis. 1988; 11:238–47.
16. Radtke HW, Peter AC, Scheuermann EH, Schoeppe W, Koch KM. Serum erythropoietin concentration in chronic renal failure: relationship to degree of anemia and excretory renal function. J Blood. 1979;54:877–83.