

Anemia and Thrombocytopenia in Acute and Chronic Renal Failure

Akbar Dorgalaleh¹, Mohammad Mahmudi², Shadi Tabibian¹, Zahra Kashani Khatib¹, GholamHossein Tamaddon³, Esmaeil Sanei Moghaddam⁴, Taregh Bamedi⁵, Shaban Alizadeh^{1*}, Eshagh Moradi⁶

¹Hematology Department, Allied Medical School, Tehran University of Medical Sciences, Tehran, Iran

²Pars Pathobiology laboratory, Minoodasht, Golestan, Iran

³Department of laboratory Sciences, faculty of paramedical sciences, Shiraz University of Medical Sciences and Health Servies, Shiraz, Iran

⁴Blood Transfusion Research Center, High Institute for Research and Education in Transfusion Medicine and Zahedan Regional Educational Blood Transfusion Center, Iran

⁵Parasitology Department, Zahedan University of Medical Sciences, Zahedan, Iran

⁶Medical Education Department, Medical Faculty, University of Medical Sciences, Tehran, Iran

Corresponding author: Shaban Alizadeh (Ph.D)

Hematology Department, Allied Medical School, Tehran University of Medical Sciences, Tehran, Iran

Email: alizadehs@sina.tums.ac.ir

Received: 12, Aug, 2013

Accepted: 26, Aug, 2013

ABSTRACT

Background: Acute renal failure describes as a syndrome by rapid decline in the ability of the kidney to eliminate waste products, regulate acid-base balance, and manage water homeostasis. When this impairment is prolonged and entered chronic phase, erythropoietin secretion by this organ is decreasing and toxic metabolic accumulates and causes hematological changes include decrease of HCT, MCV and RBC and platelet counts. This study evaluates present of anemia and thrombocytopenia in patients with acute and chronic renal failure.

Materials and Methods: This study conducted on 132 patients with renal impairment and also 179 healthy individuals as two separated control groups. Initially patients with renal problem were tested and after confirmation of impairment, patients were divided in two groups, acute with less than 3 months and chronic with more than 3 months renal failure, based on duration of the disease. Then complete blood count performed for each patient and finally obtained data were analyzed by SPSS software.

Results: Comparison between 96 patients with acute and 36 patients with chronic renal failure revealed that severity of anemia (HCT, Hb and MCV) between these two groups were statistically high in comparison with control groups ($P>0.05$) but thrombocytopenia in patients with chronic renal failure was statistically different from control and the acute ones ($P<0.001$).

Conclusion: It was recommended that in patients with chronic renal failure, to prevent the risk of bleeding, platelet count should be checked periodically.

KEY WORDS: Acute renal failure, Chronic renal failure, Anemia, Thrombocytopenia

INTRODUCTION

Renal failure is a condition in which the kidneys are unable to adequately filter toxins and waste products from the blood. It is described as a decrease in glomerular filtration rate (GFR) and can be determined by measuring the plasma clearance of different glomerular filtration markers like inulin, ethylene-diamine-tetra-acetic-acid, and etc.^{1, 2}

Renal failure classified into two forms of acute and chronic. Acute renal failure (ARF) is characterized by abrupt decline in renal filtration function.³ It is typically marked by increase in BUN and serum creatinine and decreased urine production.⁴ For simplicity, the cause of ARF is divided into sources of renal injury such as pre-renal, intrinsic and post-renal. Pre renal ARF is the limitation of blood flow

to the kidney. The common symptoms in the outpatient setting are vomiting, diarrhea, poor fluid intake, fever, use of diuretics and heart failure. Intrinsic ARF can be result from damage to kidney tubules, interstitium, and glomeruli, kidney tubules, or interstitium. Post renal ARF is due to obstruction of both or one urinary tracts.⁵ ARF is a devastating clinical problem in the surgical patients. The rate of mortality depends on underlying disease and it is much more in intensive care unit setting. Approximately 50% to 80% of patients in ICU died from ARF.³⁻⁵

Chronic renal failure (CRF) is a progressive loss in kidney function over a period of time. It is identified by higher amount of creatinine and lower glomerular filtration rate. In the early stages, there may be no symptoms but it gets worse gradually. The final stage of chronic kidney disease is an irreversible debilitating condition of kidney which requires intensive treatments of dialysis or transplantation.⁶ The adverse outcome of CRF are kidney failure, cardiovascular disease (CVD), and premature death.⁷ Different characteristics can be effective to distinguish chronic from acute renal failure. The primary differences between acute and chronic renal failure are the cause and duration of them. Duration of ARF varies from patient to patient and is affected by different factors such as the cause of the kidney problem. CRF is a lifelong problem and it tends to get worse over months or years. Presence of disease in last few months, normochromic anemia, growth failure, a history of nephritic or nephritic syndrome, high blood pressure, diabetes mellitus, kidney stone, glomerulonephritis and infection make chronic renal failure more likely.^{8,9} Acute renal failure has a sudden onset and can occur as a complication of medical conditions, surgery, or trauma. Hypovolemia due to hemorrhage or severe dehydration, hypotension, congestive heart failure, sepsis, nephrotoxins, are also seen in patients with acute renal failure.^{4,10}

Red cell production due to the Erythropoietin deficiency is too low in CRF and causes development of anemia in this situation.¹¹ Anemia is also seen in patients with acute renal failure but the exact relationship between them remained unclear.¹² In addition to anemia, platelet count also

seems to be affected by renal disorder too. The exact pattern of platelet count in patients with renal failure is controversial but several studies revealed the decrease in platelet count in renal failure.¹³

The purpose of this investigation is to evaluate the effect of acute and chronic renal failure on severity of anemia and platelet count.

MATERIALS AND METHODS

This case-control study was conducted on 96 patients with acute renal failure and 36 patients with chronic renal failure from February to April 2012 as case groups and two groups of 97 and 82 individuals as controls. Ethical approve and patients consent statement were taken from everyone and the study was performed in central hospital of Iranshahr.

At first, all patients with proven renal failure were included in study then patients were divided in two groups of acute (<3 month) and chronic (>3month) based on disease duration.

Patients with especial established disorders such as endocrinopathies, anemia, and hepatosplenomegaly and also patients with use of certain drugs such as heparin were excluded from study. During the study, no patient had blood or blood components such as fresh frozen plasma (FFP) and platelet transfusion. In order to eliminate effects of sex and age on comparison between cases and control groups, age and sex were selected in each pair of groups as similar as possible.

Initially two separate blood samples were taken from each patient, 2 ml uncoagulated sample harvest for biochemical assay and EDTA anti coagulated whole blood sample for complete blood cell count.

Serum were used to determined level of blood urine nitrogen (BUN) and creatinine, and then complete blood count were done with EDTA anti coagulated samples by Sysmex (kx 21 Japan).

Statistical analysis was done by SPSS software. Statistical independent t test was used to evaluate the significance of differences between two groups. P<.05 was considered as significant change.

RESULTS

In groups of patients with acute (49% male, 51% female) and chronic (75% male, 25% female) renal failure mean age were 58 ± 15 and 60 ± 11.5 years respectively. In control groups of acute (50% male, 50% female) and chronic (76% male, 24% female) renal failure mean ages were 59 ± 12 and 60 ± 12 years respectively.

The average level of BUN and creatinine in patients with acute renal failure were 89 ± 21 mg/dl and 2.9 ± 0.9 mg/dl and in control groups were 18 ± 6 mg/dl and 1 ± 0.4 mg/dl. In groups of chronic patients and control, the average of BUN and creatinine were 84 ± 25 mg/dl and 13.2 ± 6 and 15 ± 7 mg/dl and 1 ± 0.14 mg/dl.

Comparison between acute renal failure and the control group revealed that RBC count, hemoglobin amount and hematocrit level were significantly lower in the patient group than control group ($P < 0.001$) (Table 1).

In patients with chronic renal failure, RBC count, hemoglobin and hematocrit level, MCHC and platelet count are significantly lower than the control group ($P < 0.05$) but MCH and MCV levels are not significantly different between these two groups ($P > 0.05$) (Table 2).

DISCUSSION

Renal failure is a condition due to inadequate removal of toxins and waste products by kidneys from the blood. It classified into two types of acute and chronic.^{1, 2} Acute renal failure (ARF) is characterized by an abrupt decrease in glomerular filtration rate (GFR) and also referred clinically as a sharp increase of the serum creatinine and BUN and decreased of the urine output.⁴ Chronic renal failure (CRF) describes the gradual loss of kidney function with decrease in glomerular filtration rate and diagnosed by high level of creatinine.⁶ Anemia due to the Erythropoietin deficiency is seen in CRF and ARF.¹¹ In addition to anemia, several studies showed the decrease of platelet count in renal failure.

We aimed to evaluate anemia situation and platelet count in patients with acute and chronic renal failure in comparison with normal individuals.

Our study revealed that some red blood cell indices including RBC count and Hb, HCT and MCHC levels were significantly lower in patient group in comparison with healthy non renal affected people ($P < 0.05$) and anemia was considerable in patients with acute renal failure.

The study of Michele Hales in 1994 described the presence of anemia in 91% of patients with acute renal failure as a result of increase in urea and presence of oliguria.¹² In their study Fifty-three of the 56 patients had a mild anemia (hematocrit < 35%) during their hospital stay. This finding is compatible with our finding that a majority of our patients (87.5%) with acute renal failure had a hematocrit below 35 percent. In the study of Michele Hales, Forty-three of the patients had a hematocrit below 30%, but this finding was not observed in our patients and only 12.5 percent of patients had a hematocrit lower than 30 percent. The probable cause of this discrepancy is the serum urea level. Because Michele Hales et al., found a significant correlation between maximum serum urea and severity of anemia thus a higher serum urea in their patients in comparison with our patients can be the reason of a higher percent of patients with lower hematocrit level.¹²

Our study also revealed that acute renal failure did not cause significant thrombocytopenia and even platelet count in these patients were slightly higher in comparison to control group.

About patients with chronic renal failure we found that patients were anemic and most RBC indices including red blood cell count, Hb level, HCT concentration and MCHC level were significantly lower in comparison with the control group ($P < 0.05$).

Our findings were compatible with a similar study that was done in 1979 by HW Radtke et al., and this study showed the development of anemia in patients at different stages of chronic renal failure.¹¹ In their patients the anemia was exaggerate during progression of renal insufficiency in patients at different stages of chronic renal failure.

Results of our study were in accordance with another study that was done in 2004 revealed the presence of anemia in 47.7% of 5222 patients with chronic renal failure before dialysis. It also showed

the increased prevalence of anemia as kidney function decreased.¹⁴ They also assess the glomerular filtration rate of patients and found that prevalence of anemia was strongly associated with declining glomerular filtration rate but we did not assess our patients from this aspect.

Another important finding of our study was that platelet count was statistically significant lower than healthy individuals ($P<0.0001$). Although the mean platelet ($172.4 \times 10^3/\mu\text{L}$) count did not show that our patients have not in a potential bleeding risk but thrombocytopenia was an important risk factor for occurrence of bleeding among a minority of our study patients.

Study of Gafter U et al., in 1987 was done on the platelet count in 55 patients with end-stage renal failure on maintenance hemodialysis and in 19 predialysis patients with CRF before hemodialysis. This study showed the decrease of platelet count and mild thrombocytopenia in patients with CRF.¹³

Another similar study was done between 12/2009_2/2010 and revealed that the patients with renal failure are at high risk of bleeding due to thrombocytopenia and platelet dysfunction.¹⁵ In our study also we found a mild thrombocytopenia among our patients but only a minority of patients (8%) had a platelet count that would put patients at risk of bleeding.

Table 1. Comparison of Hematological Indices between Patients with Acute Renal Failure and Healthy Individuals

Index		Number	Mean	Std. Deviation	P. value
RBC ($\times 10^9/\mu\text{L}$)	acute	96	4.2	0.72	<0.0001
	control	97	4.8	0.51	
Hb (g/dL)	acute	96	12.2	2.04	<0.0001
	control	97	13.9	1.45	
HCT (%)	acute	96	34.6	8.87	<0.0001
	control	97	41.7	3.36	
MCV(fL)	acute	96	86.6	7.01	0.358
	control	97	85.7	7.03	
MCH(pg)	acute	96	28.5	2.81	0.310
	control	97	29.3	7.11	
MCHC(g/dL)	acute	96	32.8	1.51	0.028
	control	97	33.4	1.64	
RDW (%)	acute	96	8.2	2.79	0.094
	control	97	7.6	2.15	
PLT($\times 10^3/\mu\text{L}$)	acute	96	246.1	67.06	0.385
	control	97	238.1	51.59	
WBC($\times 10^3/\mu\text{L}$)	acute	96	13.7	1.11	0.058
	control	97	13.3	1.22	

Table 2. Comparison of Hematological Indices between Patients with Chronic Renal Failure and Healthy Individuals

Index		Number	Mean	Std. Deviation	P. value
RBC ($\times 10^9/\mu\text{L}$)	chronic	36	4.3	0.86	0.0001
	control	82	4.8	0.49	
Hb (g/dL)	chronic	36	12	2.27	0.0001
	control	82	14	1.37	
HCT (%)	chronic	36	34.8	9.27	0.0001
	control	82	41.9	3.21	
MCV(fL)	chronic	36	84.8	10.08	0.403
	control	82	86.2	6.68	
MCH(pg)	chronic	36	27.6	4.23	0.134
	control	82	29.5	7.20	
MCHC(g/dL)	chronic	36	32.4	2.08	0.008
	control	82	33.4	1.62	
RDW (%)	chronic	36	10.9	4.53	0.0001
	control	82	7.5	2.19	
PLT($\times 10^3/\mu\text{L}$)	chronic	36	172.4	90.44	0.0001
	control	75	239.4	56.928	
WBC($\times 10^3/\mu\text{L}$)	chronic	35	12.5	4.24	0.1
	control	71	13.7	1.25	

REFERENCES

- Prasad N, Barai S, Gambhir S, Parasar D, Ora M, Gupta A, et al. Comparison of glomerular filtration rate estimated by plasma clearance method with modification of diet in renal disease prediction equation and Gates method. Indian Journal of Nephrology. 2012;22(2):103.
- Russell CD, Bischoff PG, Kontzen FN, Rowell KL, Yester MV, Lloyd LK, et al. Measurement of glomerular filtration rate: single injection plasma clearance method without urine collection. Journal of nuclear medicine: official publication, Society of Nuclear Medicine. 1985;26(11):1243.
- Haller M, Schelling G. Acute kidney failure. Physiopathology--clinical diagnosis--therapy]. Der Anaesthetist. 2000;49(4):349.
- Star RA. Treatment of acute renal failure. Kidney international. 1998;54(6):1817-31.
- Thadhani R, Pascual M, Bonventre JV. Acute Renal Failure. New England Journal of Medicine. 1996;334(22):1448-60.
- Dor A, Pauly M, Eichleay MA, Held PJ. End-stage renal disease and economic incentives: the international study of health care organization and financing. National Bureau of Economic Research Cambridge, Mass., USA; 2007.
- Park J. Cardiovascular Risk in Chronic Kidney Disease: Role of the Sympathetic Nervous System. Cardiology Research and Practice. 2012;2012.
- Haroun MK, Jaar BG, Hoffman SC, Comstock GW, Klag MJ, Coresh J. Risk factors for chronic kidney disease: a prospective study of 23,534 men and women in Washington County, Maryland. Journal of the American Society of Nephrology. 2003;14(11):2934-41.
- Saucier NA, Sinha MK, Liang KV, Krambeck AE, Weaver AL, Bergstrahl EJ, et al. Risk factors for CKD in persons with kidney stones: a case-control study in Olmsted County, Minnesota. American Journal of Kidney Diseases. 2010;55(1):61-8.
- Vincent J-L, Zapatero DC. The role of hypotension in the development of acute renal failure. Nephrology Dialysis Transplantation. 2009 February 1, 2009;24(2):337-8.
- Radtke HW, Claussner A, Erbes PM, Scheuermann EH, Schoeppe W, Koch KM. Serum erythropoietin concentration in chronic renal failure: relationship to degree of anemia and excretory renal function. Blood. 1979;54(4):877-84.

12. Hales M, Solez K, Kjellstrand C. The anemia of acute renal failure: association with oliguria and elevated blood urea. *Renal failure.* 1994;16(1):125-31.
13. Gafter U, Bessler H, Malachi T, Zevin D, Djaldetti M, Levi J. Platelet count and thrombopoietic activity in patients with chronic renal failure. *Nephron.* 1987;45(3):207-10.
14. McClellan W, Aronoff SL, Bolton WK, Hood S, Lorber DL, Tang KL, et al. The prevalence of anemia in patients with chronic kidney disease. *Current Medical Research and Opinion®.* 2004;20(9):1501-10.
15. Mohamed NMB. Evaluation of Hemostatic Mechanism in Sudanese Renal Failure's Patients Admitted to Khartoum Teaching Hospital College of Medical Laboratory Science. 2010-01-01