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Study of laboratory parameters after hemodialysis for patients with chronic renal disease in Syrian patient

Seraj mresh[1], Suzanne Alshimali[2], Remal Abdulaziz Asaad[3]

[1]Department of Biochemistry and Microbiology, Tishreen University, Faculty of Pharmacy, Lattakia, Syria.

[2] Department of Laboratory Medicine, Tishreen University, Faculty of Medicine, Lattakia, Syria.

[3]Department of Biochemistry and Microbiology, Tishreen University, Faculty of Pharmacy, Lattakia ,Syria.

Abstract

Background: Hemodialysis may elicit a series of changes in blood cells upon patients suffering from chronic kidney disease(CKD).

Objective: The aim of this study was to evaluate the effects of hemodialysis on hematologic components and coagulation systems in CKD patients.

Patients and Methods: A prospective study(Before&After) conducted in 70 patients with a diagnosis of CKD who underwent hemodialysis. They were selected from department of Nephrology, Tishreen University Hospital in Lattakia-Syria between June2021 and June2022. Venous blood samples were obtained from patients before initiating hemodialysis and after session, in which laboratory parameters were compared between groups.

Results: Out of 70 patients, 42(60%) were males and 28(40%) were females, with median age of 52.76 ± 14.9 years**.** The most frequent causes of CKD were hypertension (51.4%) and hyperglycemia (24.3%). As for the following biological parameters, hemoglobin(Hb), red blood cell(RBC), prothrombin time(PT), activated partial thromboplastin time(aPTT), fibrinogen, Ca^{++}, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), were increased significantly post hemodialysis, while white blood count(WBC), neutrophil(Neut), platelets(PLT), mean platelet volume (MPV), platelet distribution width (PDW), K^{+} showed an opposite pattern which were decreased significantly after hemodialysis, $p<0.05$. After 72 hours from session, laboratory investigations were performed only in 21 patients which showed that levels of RBC and Hb were decreased significantly compared with the baseline values($p<0.05$).

Conclusion: Our study indicates that hemodialysis leads to significant changes in the levels of erythrocyte, platelets parameters, coagulation profile, and inflammatory markers, in wwhich the monitoring of these parameters is considered essential in management of CKD patients.

Keywords: Chronic kidney disease CKD, hemodialysis, coagulation.

Introduction

Renal failure is a medical condition that defined as inability of the kidneys to perform excretory function leading to retention of nitrogenous waste products from the blood [1]. Acute and chronic renal failure represent the two kinds of kidney failure [2]. Chronic kidney disease(CKD) is a growing global public health problem which is associated with an excess health care costs, high mortality and morbidity such as

cardiovascular disease, end stage kidney disease(ESKD), infection, and malignancy [3]. It is defined as either kidney damage that usually detected as urinary albumin excretion of ≥30 mg/day or a decreased glomerular filtration rate(GFR) of less than 60ml/min/1.73 m^2 for at least 3 months [4]. CKD emerge from a large number of heterogeneous disease pathways that alter function and structure of the kidney irreversibly [5].

Promptly initiation of chronic renal replacement therapy is essential to prevent uremic complications that can lead to significant mortality and morbidity [6]. Patients should be counseled to consider advantages and disadvantages of hemodialysis, peritoneal dialysis, and kidney transplantation which is considered the treatment of choice for ESKD. Selection of dialysis modality is influenced by a number of clinical and socioeconomic considerations [7]. Hemodialysis represents the most common form of kidney replacement therapy in the world. It alters composition of blood by exposing it to a contrived solution indirectly across a semipermeable membrane. Although hemodialysis normalizes some biochemical parameters of blood, hemostatic parameters and coagulation systems might be affected significantly according to the type of dialyzer membrane and by the effects of anticoagulation that used for hemodialysis procedure [8]. The Absence of the local studies that investigate these effects prompted us to perform the study to improve quality of life and survival for CKD patients. Therefore, the purpose of our study was to elucidate the changes of hematologic tests and coagulation profile during periods of follow up in patients who underwent hemodialysis.

Patients and Methods

This is a prospective study (Before& After) of a group of patients with a diagnosis of CKD attending department of nephrology at Tishreen University Hospital in Lattakia-Syria during one-year period (June 2021- June 2022). The inclusion criteria were: CKD patients of both sexes and of different age groups. The exclusion criteria were patients with one of the following: acute kidney disease(AKD), tumors and hematologic diseases. History and physical examination were performed for all patients. Patients were dialyzed with using of polyflux membranes on average two times every week, 4 hours every time without changing the dialysis parameters and medication, and all patients received regular doses of heparin sodium (Heparin-Belmed 5000 UI/ml sol). Blood was obtained from hemodialyzed patients immediately before and after hemodialysis sessions which analyzed in the hospital central laboratory in Tishreen hospital. Venous blood samples were collected in EDTA containers and tested for complete hemogram and platelet count by a hematology automated analyser (Sysmex), and in heparin containers to perform CRP test on the Flexor analyzer after centrifugation samples. In addition to, samples were collected in blood containers containing citrate anticoagulant (9:1) for assessing PT, aPTT, fibrinogen, and in blood containers containing sodium citrate 1:4 for assessing ESR. Calibration of anions was performed by using Combiline analyzer.

Ethical consideration: All patients were provided a complete and clear informed consent after discussion about the study. This study was performed following the Declaration of Helsinki.

Statistical Analysis

Statistical analysis was performed by using IBM SPSS version20. Basic Descriptive statistics included means, standard deviations(SD), median, Frequency and percentages. The Wilcoxon test was used to compare two paired groups. The Friedman test was used to detect differences between groups when

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dependent variable being measured is ordinal. All the tests were considered significant at a 5% type I error rate($p<0.05$), β:20%, and power of the study:80%.

Results

The baseline characteristics of the participants were as shown in Table 1. Ages range from 23 years to 79 years (mean 52.76 ± 14.9 years). Males represented 60% of the study population and females 40%. Patients were classified according to the etiology of renal failure as follow: hypertension which represented the most frequent cause of CKD in 36 cases (51.4%), followed by hyperglycemia in 17 cases (24.3%), congenital malformations in 6 cases (8.6%), immunological etiologies in 4 cases (5.7%), reflux nephropathy in 4 cases(5.7%), and neurogenic bladder in 3 cases(3.3%).

Table 1: Demographic characteristics of the study population

Variable	N%
Sex	
Male	42(60%)
Female	28(40%)
Age(year)	52.76 ± 14.9 (Range 23 to 79)
Etiology of CKD	
Hypertension	36(51.4%)
Hyperglycemia	17(24.3%)
Congenital malformation	6(8.6%)
Immunologic etiologies	4(5.7%)
Reflux nephropathy	4(5.7%)
Neurogenic bladder	3(3.3%)

After hemodialysis, complete blood count showed highly statistically significant increasing in levels of RBC (3.58±0.7 versus3.36±0.6, p:0.0001), Hb (9.63±1.9 versus8.94±1.7, p:0.0001), and significant decreasing in WBC (5.004±1.9 versus 6.23±1.9, p:0.0001), neutrophil(Neut) (3.64±1.7 versus4.33±1.77,p:0.0001), platelet (190.02±80.5 versus 203.55±79.1, p:0.0001), MPV (9.49±1.2 versus 10.42±1.09, p: 0.0001), and PDW (13.06±3.4 versus13.43±3.2,p:0.0001).

Table2 Changes in complete blood count Pre/Post hemodialysis in CKD patients

Variable	Pre HD Mean± SD	Post HD Mean± SD	P-value
Hb(g/dl)	8.94±1.7	9.63±1.9	0.0001
RBC (10^6/µL)	3.36±0.6	3.58±0.7	0.0001
WBC (10^3/µL)	6.23±1.9	5.004±1.9	0.0001
NEUT (10^3/µL)	4.33±1.77	3.64±1.7	0.0001
Platelet (10^3/µL)	203.55±79.1	190.02±80.5	0.0001
MPV (FL)	10.42±1.09	9.49±1.2	0.0001
PDW (FL)	13.43±3.2	13.06±3.4	0.0001

We measured the levels of fibrinogen, PT, aPTT in the plasma of 70 hemodialysis patients to assess the state of alterations in the coagulation in CKD patients after performing hemodialysis. Levels of fibrinogen, PT, aPTT were significantly increased; (487.15±92.1 versus 424.21±84.3, p:0.0001), (90.55±12.8 versus 82.25±10.08, p:0,0001), and (31.73±7.1 versus 26.29±3.02, p:0.0001) respectively.

Table 3 Changes in coagulation markers in CKD patients after hemodialysis

Variable	Pre HD	Post HD	P-value
PT (%)	82.25±10.08	90.55±12.8	0.0001
aPTT (Sec)	26.29±3.02	31.73±7.1	0.0001
Fibrinogen (mg/dl)	424.21±84.3	487.15±92.1	0.0001

As shown in table (4), levels of ESR, CRP were significantly increased after hemodialysis; (46.34±25.7 versus 38.41±23.4, p:0.0001),(20.46±16.8 versus 11.19±14.8,p:0.0001) respectively.

Table 4 Changes in inflammatory markers in CKD patients after hemodialysis

Variable	Pre HD	Post HD	P-value
ESR (mm/hr)	38.41±23.4	46.34±25.7	0.0001
CRP (mg/L)	11.19±14.8	20.46±16.8	0.0001

Levels of serum Ca++ were significantly increased after hemodialysis (1.17±0.1 versus 0.96±0.1,p:0.0001), whereas levels of K+ were significantly decreased (3.82±0.7 versus 5.49±1.1,p:0.0001).

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Table 5 Changes in anions levels in CKD patients after hemodialysis

Variable	Pre HD	Post HD	P-value
Ca^{++} (mmol/L)	0.96±0.1	1.17±0.1	0.0001
K^{+} (mmol/L)	5.49±1.1	3.82±0.7	0.0001

Patients were followed up to determine changes in laboratory tests after 72 hours of hemodialysis, but 49 cases were excluded due to incomplete laboratory data. As show in table (6), we found that levels of CBC and Hb were increasingly elevated post hemodialysis (3.61±0.6 versus 3.37±0.6) and (9.56±1.5 versus8.75±1.3) respectively, then declining on third day; 3.11±0.6 and 8.37±1.5, p:0.0001. Platelet count, MPV, and PDW were significantly decreased after hemodialysis (209.66±91.4 versus 222.76±89.1), (9.26±0.9 versus 10.38±1.1), and (11.24±2.7 versus11.74±2.9) respectively, then increasing on third day; 217.95±88.8, 9.62±0.8, and 11.49±2.6, p:0.0001. Markers of coagulation represented by PT, aPTT, and fibrinogen were increased significantly after hemodialysis (91.42±8.8 versus 83.47±9.07),(31.13±2.7 versus 26.10±3.08) and (497.33±109.4 versus 433.47±111.5) respectively, and then declining on third day; 84.90±7.9, 29.10±3.09, and 455.95±110.4 respectively. Regarding of inflammatory parameters, the mean values of ESR, CRP before hemodialysis were 37.42±20.3,13.80±20.3 respectively which increased significantly post hemodialysis as follows; 42.76±20.7, 21.63±19.7, and then declined on third day; 39.52±20.6, 14.90±20.01, respectively. Levels of Ca^{++} were increased after hemodialysis (1.18±0.1 versus 0.99±0.08) and then decreased significantly on third day 1.10±0.1, p:0.0001, whereas levels of K^{+} were decreased after hemodialysis; 4.31±0.7 versus 5.57±0.8 and then increased on third day 5.27±0.7, p:0.0001.

Discussion

CKD patients undergoing hemodialysis may show hemostatic alterations through complex interactions of many mechanisms. The present study demonstrated the main findings. First, approximately two-third of the patients were males and most of them were elderly. Second, there were many etiologies that led to occurrence of CKD in which hypertension and diabetes mellitus represented the most frequent causes. Third, the main reported hemostatic changes in CKD patients after hemodialysis were increased levels of Hb, RBC, PT, aPTT, fibrinogen, Ca^{++}, ESR, CRP and decreased levels of WBC, NEUT, platelets, MPV, PDW, K^{+} with presence of significant differences($p<0.05$). Finally, patients who were followed up for 72 hours demonstrated a significant decreasing in levels of Hb and RBC. These findings might be explained as follow: hemodialysis results in platelet activation, lose their discoid shape, become irregularly spherical with a reduction of their mean platelet volume (MPV). In addition to, hemodialysis causes decreased activity of coagulation factors, and systemic inflammatory response that reflected mainly by elevated CRP. In contrast to previous reports of hematologic changes in CKD patients who underwent hemodialysis which found that levels of Hb and RBC were decreasing post hemodialysis, so we repeated measurements after 72 hours. Levels were decreased which might be explained by decreasing volume of fluid, increasing plasma and compensation that occurs after 72 hours. The results of current study are comparable with the previous studies. Abdullah et al (2012) demonstrated in a study conducted in 100 patients with CKD that levels of PT, aPTT, and fibrinogen were increased significantly post hemodialysis with concurrent decrease of platelet counts [9]. Mohammed et al (2015) demonstrated in a study conducted in 161 patients with a

diagnosis of CKD that values of ESR were raised post-dialysis in most of the stable patients on regular hemodialysis and was significantly higher than the pre-dialysis ESR [10]. Pandian et al (2016) showed in a study conducted in 120 patients with a diagnosis of CKD that levels of Hb, RBC, PLT, WBC and neutrophil were decreased post hemodialys[11]. Lakshmi et al (2018) showed in a study conducted in 25 patients with a diagnosis of CKD that calcium concentration was increased whereas potassium concentration was decreased post hemodialys[12]. Hernaningsih et al (2019) showed in a study conducted in 50 patients with a diagnosis of CKD that aPTT showed a significant increasing after hemodialysis, p:0.03[13]. Muhammad et al (2020) found in a study conducted in 120 hemodialysis patients that post- hemodialysis the mean value of RBC and Hb were increased significantly whereas levels of WBC and platelets were decreased [14].

Table 6 Comparison changes in laboratory markers in CKD patients at 72 hours post hemodialysis (21 patients)

Variable	Pre HD	Post HD	After 72 h	P-value
CBC				
Hb(g/dl)	8.75±1.3	9.56±1.5	8.37±1.5	0.0001
RBC (10^6/µL)	3.37±0.6	3.61±0.6	3.11±0.6	0.0001
WBC (10^3/µL)	6.61±2.4	5.44±2.5	6.22±2.4	0.0001
NEUT (10^3/µL)	4.73±2.1	4.10±2.2	4.58±2.1	0.0001
Platelet (10^3/µL)	222.76±89.1	209.66±91.4	217.95±88.8	0.0001
MPV (FL)	10.38±1.1	9.26±0.9	9.62±0.8	0.0001
PDW (FL)	11.74±2.9	11.24±2.7	11.49±2.6	0.0001
Coagulation markers				
PT (%)	83.47±9.07	91.42±8.8	84.90±7.9	0.0001
aPTT (Sec)	26.10±3.08	31.13±2.7	29.10±3.09	0.0001
Fibrinogen (mg/dl)	433.47±111.5	497.33±109.4	455.95±110.4	0.0001
Inflammatory markers				
ESR (mm/hr)	37.42±20.3	42.76±20.7	39.52±20.6	0.0001
CRP (mg/L)	13.80±20.3	21.63±19.7	14.90±20.01	0.001
Anions levels				
Ca^{++} (mmol/L)	0.99±0.08	1.18±0.1	1.10±0.1	0.0001
K^+ (mmol/L)	5.57±0.8	4.31±0.7	5.27±0.7	0.0001

Conclusion:

In summary, monitoring of hematologic parameters in CKD patients may guide follow-up and management to take preventive measurement before hemodialysis to reduce complications.

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