Retrospective study of renal function and hematologic indices of patients undergoing dialysis at Mistura Medical Centre, Libya

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تاريخ الاستلام 2024-04-24

Abstract

Chronic renal disorder is one of the diseases of public health concern. Epidemiological evidence revealed that this condition's incidence and prevalence are increasing globally. Renal disease has been implicated in the disruption of normal hematological dynamics, leading to a reduction in the quality of life, higher cost of management, and increased mortality. Meanwhile, it is not clear whether this derangement in hematological parameters can be influenced by routine dialysis.

This present study evaluated the retrospective hematological profile, and plasma creatinine and urea of male and female CKD patients who are undergoing dialysis. The data of hematological indices and kidney function biomarkers were obtained from patients undergoing dialysis and healthy individuals (both male and female) at the Dialysis Clinic of Mistura Medical Centre, Libya from 1st January to 31st December 2022. The data of 100 individuals were analyzed with SPSS statistical software package. P values less than 0.05 were set as statistically significant.

The results revealed that there are more female patients below the age of 40 years undergoing dialysis within the study population than the number of male patients within the same age bracket. Furthermore, generally significant reductions in most of the hematological parameters in patients undergoing dialysis compared with normal male and female individuals. The levels of urea and creatinine increased significantly in both males and females undergoing dialysis compared to normal individuals.

Conclusively, it is observed that the derangement of kidney function biomarkers, the hallmark of CKD is sustained coupled with the depressed hematological indices while undergoing dialysis. It will be therefore not out of place to suggest that another treatment regimen should be applied along with dialysis.

Keywords: patients, kidney function, hematology, dialysis

Introduction

Chronic kidney disease (CKD) is a condition of global health concern that afflicts humans without geographical boundaries and is one of the leading causes of death worldwide (Paidi *et al*., 2021; Mahalingasivam and Caplin, 2019; Abraham *et al*., 2019). It is a disorder characterized by a gradual and progressive loss of renal functions and declined glomerular filtration rate (GFR) (Elendu *et al*., 2023). It has a massive negative impact on the world's cost of health care, growth, and productivity (Fox *et al*., 2012). The development of the illness is multifaceted and is predisposed by factors such as age, lifestyle, culture, socioeconomics, and comorbidities (diabetes mellitus, cardiovascular disease, obesity) (Hill *et al*., 2016).

As a result of non-access, it is projected that the majority of CKD patients may end up with end-stage renal disease (ESRD) and eventually lead to death, especially in low-to-middle-income countries (LMICs) (Liyanage *et al*., 2015; Anand *et al*., 2013). The total number of global CKD occurrences was projected to be more than 800 million individuals (Kovesdy, 2022). Global Burden of Disease data indicates that Libya is among the countries in North Africa and the Middle East with CKD as the top ten causes of death (GBD, 2015). Family history is 50% linked to CKD while 4.9% has no identifiable causes. In addition, diabetes mellitus is the leading cause of CKD followed by glomerulonephritis and hypertension in Libyan patients (Habas *et al*., 2016). Previous studies have revealed that CKD progression affects hematological parameters (Singh and Bhatta, 2018). Specifically, derangement in red blood cell (RBC) count, hemoglobin (Hb), total leukocyte count (TLC), hematocrit (Hct), white blood cell (WBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCMC), and platelet count have been reported in chronic kidney disease (Hsu *et al*., 2001; Locatelli *et al*., 2007; Katz, 2005). Similarly, biochemical indexes such as urea and creatinine levels in the blood have also been shown to be deranged in CKD (Hossain *et al*., 2017; Latiwesh *et al*., 2017).

CKD treatment is administered to delay disease advancement, manage the complications and the associated symptoms, and improve the quality of life of the patients. These management procedures include; control of blood pressure and sugar level, dietary modification, drugs for managing complications, and dialysis or renal replacement therapy (RRT) (Elendu *et al*., 2023). However, access to dialysis and RRT are both affected by high costs while RRT access is compounded

by the lack of cadaveric donors in many parts of the world. In 2017 alone, about 4 million people underwent dialysis (Jager *et al*., 2019). On the other hand, about the same number of CKD patients have no access to this therapy all over the world (Liyanage *et al*., 2015). Furthermore, in Africa, only about 9 –16% have access to this therapy while a lack of it leads to end-stage CKD and death (Krzesinski *et al*., 2007; Liyanage *et al*., 2015).

The present study therefore is aimed at investigating the dynamics of hematological parameters and markers of kidney health in patients undergoing dialysis compared with apparently healthy individuals at Mistura Hospital, Libya.

Materials and Methods

This study is retrospective including patients undergoing dialysis at the Dialysis Clinic, Mistura Medical Centre, and healthy individuals who are not undergoing dialysis. The data were obtained from patients (both male and female) diagnosed with kidney problems who are undergoing dialysis at the Dialysis Clinic of Mistura Medical Centre from 1st January to 31st December 2022 and the data from individuals without kidney issues. The data collected are hematological indices and kidney function biomarkers of 25 male and 25 female patients culminating in 100 individuals.

Statistical Analysis

SPSS statistical software package (SPSS Inc., Chicago IL, USA) version 15.0 was used for the analysis of the data by adopting the Chi-square test, student t-test, and ANOVA appropriately. P values less than 0.05 were set as statistically significant.

Results and Discussion

Table 1: Hematologic indices and Renal function Biomarkers of Apparently normal and Male Patients

			Normal Males								
	Number of Subjects	WBC* 10^9/L	RBC*1 0^12\L	H.G g/L	HCT L/L	MCV fL	MC H Pg	MCH C g/L	PLT *10^3/ ML	urea mg/dl	Creatini ne mg/dl
Belo w 40	12	7.13 ± 0.36	4.93 ± 0.12	14.27 ± 0.36	43.00 ± 0.97	87.50 ± 0.87	28.17 ± 0.42	32.17 ± 0.21	265.20 ± 14.43	26.53 ± 1.72	0.58 ± 0.05
Abo ve 40	13	6.99 ± 0.59	4.967 ± 0.15	14.09 ± 0.24	41.15 ± 3.18	88.23 ± 1.29	27.54 ± 0.45	31.08 ± 0.24	193.50 ± 14.20	28.21 ± 1.83	0.52 ± 0.05
			Male Patient s								
	Number of Subjects	WBC* 10^9/L	RBC*1 0^12\L	H.G g/L	HCT L/L	MCV fL	MC H Pg	MCH C g/L	PLT *10^3/ ML	B.Um g/dl	Creatini ne mg/dl
Belo w 40	5	5.62 ± 1.00	3.34 ± 0.28	9.60 ± 0.82	31.10 ± 2.95	92.40 ± 2.73	28.00 ± 0.95	30.40 ± 0.51	178.20. 41.10	127.60 ± 12,21	7.52 ± 1.14
Abo ve 40	20	6.95 ± 0.42	3.35 ± 0.16	9.39 ± 0.40	28.73 ± 1.15	90.35 ± 1.38	28.09 ± 0.58	31.13 ± 0.33	189.20 ± 13.87	130.80 ± 5.02	8.60 ± 0.35

Data were expressed as Mean±SD of n=12 and 13 for normal male subject while n=5 and 20 for patients undergoing dialysis of below and above 40 years of age respectively.

Table 2: Hematologic indices and Renal function Biomarkers of Apparently normal and Female Patients

			Norma l								
	Number of Subjects	WBC* 10^9/L	RBC*1 0^12\L	H.G g/L	HCT L/L	MC V fL	MCH Pg	MCH C g/L	PLT *10^3/ ML	ureamg/dl	Creatinin e mg/dl
Belo w 40	9	13.69 ± 6.45	3.62 ± 0.07	10.33 ± 0.40	32.67 ± 1.30	92.22 ± 1.90	28.56 ± 0.67	30.89 ± 0.39	184.60 ± 32.38	25.27 ± 2.25	0.54 ± 0.06
Abo ve 40	16	6.19 ± 0.48	3.45 ± 0.15	10.46 ± 0.42	32.56 ± 1.42	93.98 ± 1.24	29.46 ± 0.57	31.43 ± 0.35	178.40 ± 18.66	30.57 ± 1.54	0.51 ± 0.05
			Patient s								
Belo w 40	13	11.55 ± 4.49	3.56 ± 0.12	10.83 ± 0.38	33.84 ± 1.32	94.28 ± 1.42	29.72 ± 0.60	31.38 ± 0.41	154.80 ± 22.24	177.30 ± 27.80	8.56 ± 0.61
Abo ve 40	12	6.01 ± 0.54	3.46 ± 0.16	9.97 ± 0.45	31.25 ± 1.48	92.33 ± 1.53	28.50 ± 0.60	31.08 ± 0.34	208.60 ± 22.02	150.10 ± 11.85	7.60 ± 1.04

Data were expressed as Mean±SD of n=9 and 16 for normal female subject while n=13 and 12 for patients undergoing dialysis of below and above 40 years of age respectively

Over 3 million people have been reported to die annually as a result of lack of access to therapy. In many cases, the therapy for CKD is usually not curative. Still, such treatment is administered to the patients to slow down the rate of advancement of the disease, manage the complications and the associated symptoms, delay or prevent the initiation of end-stage renal disease, and improve the quality of life of the patients. These management procedures include; control of blood pressure and sugar level, dietary modification, drugs for the management of complications, and dialysis or renal replacement therapy (RRT) (Elendu *et al*., 2023).

Globally, the number of patients who require dialysis and RRT increases daily (Schena, 2000). However, of all the available treatment options, access to dialysis and RRT are largely affected by high costs in many parts of the world. In LMICs, the problem is even more severe (Jha, 2009; Krzesinski *et al*., 2007). In 2017 alone, about 4 million people underwent dialysis (Jager *et al*., 2019). On the other hand, about the same number of CKD patients have no access to this therapy all over the world (Liyanage *et al*., 2015). Furthermore, in Africa, only about 9 – 16% have access to this therapy leading to the death of many patients across the continent (Krzesinski *et al*., 2007; Liyanage *et al*., 2015).

The renal disorder can arise from cellular injury which might be a result of exposure to a wide array of toxicants with capacities to impact a significant insult on the renal cells. The significant risk factors for CKD include diabetes mellitus, hypertension, and obesity. Meanwhile, in this region of the word, hematological profiles are not often investigated in people living with CKD. However, previous

studies have revealed that there is a significant reduction in hematological parameters in CKD patients (Latiwesh *et al*., 2017). Erythrocyte indices are the most affected hematological parameters in CKD. Apart from erythrocyte indices, leukocyte count, platelet count, and WBC among others are also affected in CKD patients (Akinsola *et al*., 2000). To the best of our knowledge, it is not clear, whether these deranged hematological indices persist in patients undergoing dialysis.

In this study as depicted in Table 1 and 2, we observed the following; first, there are more female patients below the age of 40 years undergoing dialysis within the study population than the number of male patients within the same age bracket. Secondly, there is generally marked reduction in most of the hematological parameters investigated in patients undergoing dialysis compared with normal individuals in both males and females. Finally, the concentration of urea and creatinine increased significantly in both male and female patients undergoing dialysis when compared with that of normal male and female individuals (Table 1 and 2).

The role of RBC is primarily the transportation of oxygen (O_2), carbon dioxide (CO_2), nutrients, and various other important molecules around the entire body (Kaminski *et al*., 2014). Previously, it had been established that a decrement in the quantity of circulating RBCs as observed in this study refers to a pathological condition that is known as anemia. Anemia is generally characterized by a concentration of whole blood hemoglobin that is lower than 13 g/dL and 12 d/dL in males and females respectively (WHO, 2011; Kuhn *et al*., 2017).

The present study is characterized by a marked reduction in the number of RBC counts in both the male and female patients undergoing dialysis in the two age

brackets studied when compared with the RBC counts for both normal males and females (Table 1 and 2). Similarly, the hemoglobin counts for both male and female patients were also below the normal values of 13 g/dL and 2 g/dL respectively for males and females. This data as obtained in the present study also confirms the likely incidence of anemia in both male and female patients undergoing dialysis.

One of the major complications of CKD is anemia and this is associated with a reduction in the quality of life of CKD patients (Lefebvre *et al*., 2006), and elevated morbidity and mortality (Astor *et al*., 2006; Kovesdv *et al*., 2006). Furthermore, reduction in the endogenous production of erythropoietin, as a consequence of reduced GFR, iron deficiency, as well as inflammation due to elevated levels of hepcidin have been postulated as some of the mechanisms associated with CKD-induced anemia (Portoles *et al*., 2021; Batchelor *et al*., 2020; Wish, 2006).

WBCs participate in the immune and inflammatory process and are responsible for protection against all pathogens (Qureshi, 2016). It is a traditional marker for systemic inflammation (Fan *et al*., 2017). WBC and platelet (PLT) counts are also affected in CKD and may also be a result of reduced levels of erythropoietin, increased hemolysis, hematuria, suppressed erythropoiesis in the bone marrow, and blood loss in the gastrointestinal tract (George *et al*., 2015; Shenkut *et al*., 2024). The data obtained from the present study reveals a reduction in the WBC count in both male and female CKD patients compared with that of normal individuals indicating CKD-induced leukopenia in CKD patients who are undergoing dialysis. Several studies have postulated that WBC count may be linked with renal function (Costello-White *et al*., 2015).

Leukopenia, as observed in the present study can be an indication of lowered immunity level or immunosuppression (Gardner *et al*., 2016). This is expected to subject CKD patients to higher risks of susceptibility to opportunistic infection, incidence of more severe complications, and even death.

Platelets are small blood cells. The most studied function of platelets is the activation of thrombosis, and bleeding control/wound healing. Platelets are therefore vital for the maintenance of an appropriate volume of blood during vascular injury (Fountain and Lappin, 2023). The platelet counts in both male and female patients are significantly lower than those of normal individuals indicating CKD-induced thrombocytopenia. This CKD-induced thrombocytopenia is expected to increase the bleeding period which can be life-threatening.

MCV, MCH, and MCHC are generally referred to as RBC indices. These hematological parameters are measures of the size and quality of the hemoglobin component of RBC (Walker *et al*., 1990). The size of RBC is defined by MCV, while MCH indicates the number of hemoglobin per RBC. MCHC is a measure of the quantity of hemoglobin per unit volume (Asberg *et al*., 2014). Altogether, these RBC indices are applicable in the diagnosis of anemia. Specifically, microcytic anemia is characterized by low levels of MCV and MCH. On the other hand, a low level of MCHC defines hypochromic anemia (Sonali *et al*., 2023; Abdelgader *et al*., 2014; Tunkyi and Moodley, 2017).

As noted earlier, previous studies have shown that there is a positive correlation between CKD and anemia, and as such anemia has been identified as the most common complication associated with CKD (Hain *et al*., 2023). To postulate that the observed anemia in CKD patients undergoing dialysis follows the same mechanism highlighted above is not out of order (Tables 1 and 2).

HCT is a measure of packed RBC related to the whole blood. It is also referred to as packed cell volume (PCV). It is also a marker for anemia or polycythemia (Mondal and Lotfollahzadeh, 2023; Hsu *et al*., 2001). The reduction in the quantity of HCT as observed in this study is another pointer to CKD-induced anemia.

Tiredness, chest pain, shortness of breath, and memory loss are some of the symptoms that have been linked with CKD-induced anemia (Mathias *et al*., 2020). The reduced renal function experienced by CKD patients is expected to be significantly accelerated when anemia is left unmanaged leading to alteration of kidney hemodynamic and tissue hypoxia (George *et al*., 2018). This is expected to increase the suffering of CKD patients and also increase the cost of treatment and/or management.

Ammonia is a major byproduct of protein catabolism, the ammonia so generated is converted by hepatic enzymes to urea in the liver and this urea accounts for about 90% of non-protein nitrogenous (NPN) waste product (Salazar, 2014, Fatoki *et al*., 2019). An elevated level of blood urea nitrogen (BUN) therefore can be a result of intake of a protein-rich diet or reduced excretion through the kidney as a result of renal diseases (Fatoki *et al*., 2019). Similarly, creatinine is another metabolic waste classified as an NPN waste product. Creatinine is produced when creatine and phosphocreatine are broken down in the body. It is also another vital marker for renal function, which is less affected by diet unlike BUN (Price and Finney, 2000). Previous studies have implicated elevated blood creatinine levels as one of the major consequences of impaired renal function (Fatoki *et al*., 2019).

The elevated BUN and creatinine concentrations observed in CKD patients undergoing dialysis in this study are in total agreement with many previous studies

that reported elevated plasma levels of urea and creatinine in CKD patients (Tables 1 and 2).

The persistent derangement of hematological indices and kidney function biomarkers while undergoing dialysis as observed in this study is a pointer to the need to augment with the additional treatment options along with dialysis of CDK patients.

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