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Original article

Alteration of Blood Parameters in Non-Dialyzed Patients of Chronic Kidney Disease

Najat Mohammed[1]*, Tahani Mohammed[2], Nisreen Farag[1]

[1]*Department of Medical Laboratory, Faculty of Medical Technology, Omer AL-Mukhtar University, EL-Beyda, Libya*
[2]*Department of Anesthesia, Higher Institute for Science and Technology, EL-Beyda, Libya*
Corresponding Email. *Najat.mohammed@omu.edu.ly*

Abstract
Chronic kidney disease (CKD) is a serious health problem that can lead to end-stage renal disease. Patients with CKD are usually suffered from anemia, which is one of the major consequences of kidney damage which in turn lead to reduce quality of life, increased risk of cardiovascular disease and cognitive impairment. The study aimed to assess the hematological abnormalities in the CKD patients during pre-dialyzed conditions in EL-Beyda City. The study was included 107 patients who are attended to Nephrology Department in EL-Bayda Medical Center in the period from November 2021 to March 2022. The study was included all CKD stages and were not on dialysis and they were following upped by these centers regularly each month. Data sources were obtained from the personal interview with patients and the records files in Nephrology units. Blood samples were taken in EDTA tube to measure complete blood counts (CBC) include hemoglobin (Hb), hematocrit (HCT), Mean cell volume (MCV), Mean cell hemoglobin (MCH), Mean cell hemoglobin concentration (MCHC), white blood cells (WBC) and platelets count (PLT), as well as renal function tests (blood urea and creatinine). The data were analyzed by Minitab version17. Out of 107 patients were included in this study, 63(58.8%) of patients were females and 44(41.1%) were males, The majority of patients had chronic diseases which could be the contributing cause of CKD; 62% were suffered from hypertension, 40% suffered from diabetes. Anemia was the main abnormality in our study which observed in 49 of participants (45.8%) while the others were non anemic accounting 54% (14.6±0.23). There was a significant difference in the mean of hemoglobin and hematocrit between anemic and non-anemic participants (*p- value=0.000*). Red cell indices showed normocytic normochromic anemia, thrombocytopenia was noticed in 7 (14%) of patients and leukocytosis was reported in 9 (18%) of them. We can conclude that developing of anemia in CKD patients is associated with poor outcomes and requires a careful management to avoid comorbidities.
Keywords. Chronic Kidney Disease (CKD), Hematological Changes and Anemia.

Introduction

CKD is a serious health problem that can lead to end-stage renal disease (renal failure), medically, chronic kidney disease is diagnosed if there is reduced excretory kidney work (GFR≤ 60mL/min) or proteinuria for more than 3 months [1]. Which further can be classified into four stages according to the filtration rate value; stage 1 (GFR >90), stage 2 (GFR 60-90), stage 3(GFR30-60), stage 4 (GFR 15-30) and stage five (GFR<15) [2-5].

Since the kidney is the main source of erythropoietin, about 90% is produced by juxtaglomerular apparatus thus EPO insufficiency is a common cause of anemia in the people with CKD [6,7]. The development of anemia of chronic kidney disease (ACD) is caused by a number of intricate mechanisms including reduced RBC lifespan [8], decreased of iron release from its cellular reserves, reducing iron absorption from the intestinal mucosa and inability of bone marrow to promote erythropoiesis [6]. As a result, erythroid progenitor cells acquire less iron to complete their maturation. All of these factors play a role in the onset of ACD [9].

Renal clearance decreases with time in chronic kidney disease, resulting in the accumulation of urea, creatinine and as well as other toxic compounds in the blood [3,10]. The normal serum creatinine level ranges from 0.5 to 1.0 mg/dl, depending on diurnal and menstrual variations, exercise and diet[3]. Urea is a nitrogen-containing chemical molecule that plays an important function in the metabolism of other nitrogen-containing substance [3,7]. Elevated levels of plasma urea and creatinine are indicating that the kidneys aren't performing properly. Kidney diseases are usually secondary to other primary causes and some of the developing countries have reported that diabetes (DM) and hypertension (HTN) are the most prominent risk factors of the renal problems [11]. In the last decade, the incidence of CKD is getting high parallel with increase the prevalence of diabetes and hypertension estimating about 13-15% [7]. Recent Swedish studies have shown that the prevalence of anemia in non-dialysis patients is about 60% and reach to 93% in dialysis dependent patients [12]. Other findings have reported that the severity of anemia was raised with progression of kidney failing [13]. Patients with chronic kidney disease are usually develop normochromic normocytic anemia, sometimes microcytic hypochromic [6]. A numerous of the previous studies showed that CKD anemia is contributed to reduced quality of life and predisposing to cardiovascular disease, hospitalizations, cognitive impairment, and mortality [14,15]. Some findings have reported that

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CKD could affect other hematological parameters including eosinophilia, prolonged bleeding time and thrombocytopenia [16]. The objective of the present study aimed to assess the hematological abnormalities in the CKD patients during pre-dialyzed conditions in EL-Beyda city.

Methods

Study design and setting

The study was included 107 patients who were attended the nephrology department in EL-Bayda Medical Center in AL-Bayda in the period from November 2021 to March 2022. All of the patients were diagnosed with chronic kidney diseases (depending on GFR less than 90/min). The study was included all CKD stages (stage 1 to stage 4) and not under dialysis and they were following upped by these centers regularly each month which provide accurate diagnostic and laboratory tests for those patients.

Data collection

Data sources were obtained from the personal interview with patients and the records of patient's files in nephrology units. Blood samples were taken in EDTA tube to measure complete blood counts (CBC) include hemoglobin (Hb), hematocrit (HCT), white blood cells (WBC), platelets count (PLT), Mean Cell Volume (MCV), Mean cell hemoglobin (MCH) and Mean cell hemoglobin concentration (MCHC) which were assessed by hematology analyzer (Diagon-D Cell 60) as well as blood urea and creatinine were measured by Photocytometry 4040.

Data analysis

The data obtained were analyzed by Minitab version 17and the results were presented as mean±SE, percentage and *P-value* less than 0.005 was considered significant.

Results

Out of 107 patients included in this study, 63 of patients were females and 44 were males, with the mean age was 59.23±0.23 years (Table1). The most common age group was (60-79) with 46% followed by age group (40-59) with 25.6%, while few cases were found in age group (0-19), (20-39) with 2%, and 12% respectively (Figure 1).

Table 1. gender wise distribution of the CKD patients

Gender	Number (107)	Anemic patients	Prevalence %	Non anemic	Prevalence
Male	44(41%)	23	45.8%	21	55.2%
Female	63(58.9%)	26		38	

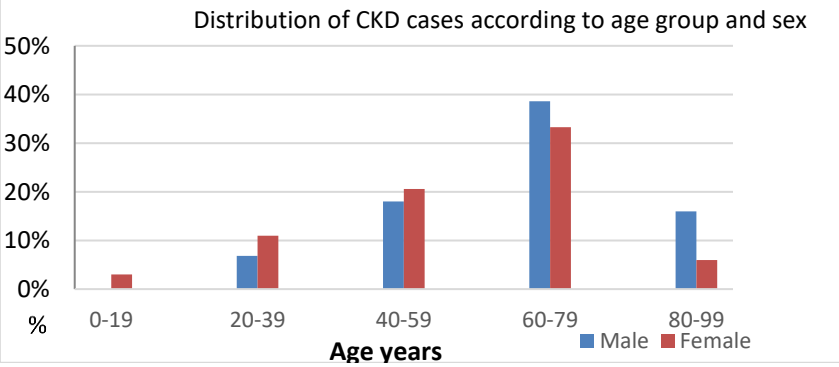

Figure 1. Distribution of CKD cases by gender and age

Depending on the information obtained from patient's files; the majority of patients had primary chronic diseases which are the most contributing cause of kidney problems; 62% were suffered from hypertension, 40% were suffered from diabetes militias, 37% had both hypertension and diabetes, while others cause such as thyroid dysfunction, post covid and polycystic kidney reported in minor cases (Figure 2).

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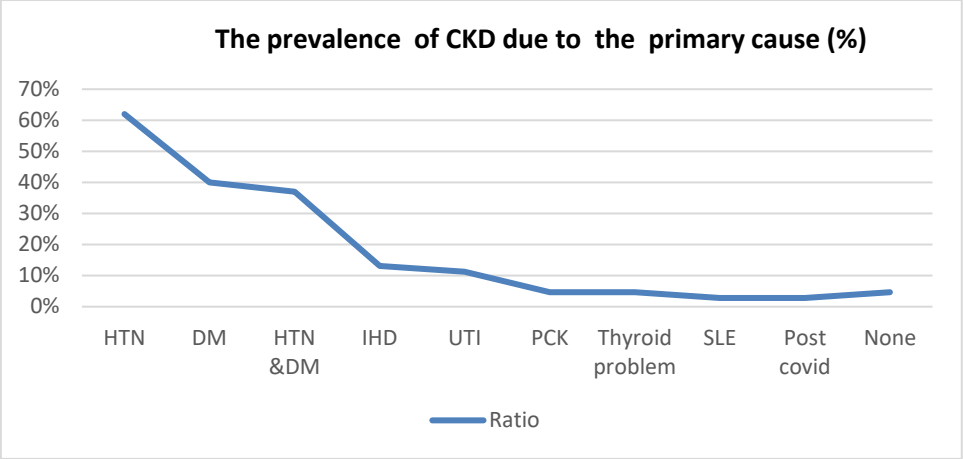

Figure 2. The percentage of CKD patients in relation to primary causes

Among CBC results of 107 samples, 49 (45.8%) of them were anemic and mean of patient's hemoglobin was found to be (10.1±0.24) which is significantly lower than the mean hemoglobin of non-anemic groups (mean14.6±0.23) (*p- value=0.000*) (Table 2).

Table 2. Mean and standard error of anemic and non- anemic patients and p value

Parameters (Mean±SE)	Anemic patients	Non-anemic Patients	P-value
Hemoglobin	10.1±0.24	14.6±0.23	0.000***
HCT	31.15±0.78	41.7±1.6	0.000***

Others hematological parameters including MCV as well as MCH and MCHC were within normal range and not affected to all cases (normocytic). However, thrombocytopenia was found in 7 (14%) of patients and leukocytosis was reported in 9 (18%) of them. Biochemical tests especially urea was high in all CKD patients with mean 96 mg/dl and mean of serum creatinine was 3.07mg/dl as seen in (Table 3).

Table 3. The hematological values in term of mean± standard error for CKD patients

Parameters	Mean±SE
WBC (10^9/ L)	8.79±0.62
MCV (FL)	87.8±3.09
MCH (Pg)	29.57±0.54
MCHC (g/dl)	31.54±1.45
PLT (10^9/L	238±10.9
B. urea (mg/dl)	96.19±5.47
S.Creatinine (mg/dl)	3.078±0.22

Discussion

Chronic kidney disease is a major public health issue that causes significant morbidity and mortality around the world. The rate of kidney damage is used as indicators to diagnose stages of kidney diseases. Our study found that the most of CKD patients were elderly with the mean age 59.23 years and 46% of them were in age group 60-79 years, which are consistent with other studies in India, Malaysia, and the northwest of Ireland who published that the renal impairment developed in elderly peoples as result of reduced glomerular filtration rate with increasing age [17]. In contrast, this contradict a study in Tripoli showed that nearly two-thirds of the patients were aged 40 years, and about one-third were aged 60 years or more (38.7%) [18].

The present study demonstrated that the overall prevalence of anemia was 45.8%. This finding is in agreement with research conducted in Nigeria with 54.5%. Similar reports came from Catalonia and Spain with (58.5%), North Korea (44.9%), and China (51.5%). However, the prevalence was relatively low in United States and Japan accounting 15.4 % and 32.3% respectively [11].

Some researchers revealed that 86.7% of CKD patients in Ghana had anemia at the time of presentation[19]. Similarly, a study conducted in Enugu-Nigeria showed that 77.5 % of CKD patients were anemic, and 94.3% of patients of end stage renal disease were suffered from anemia [20]. The main cause of reducing of hemoglobin level in CKD peoples is due to insufficient erythropoietin production since that 90% of EPO comes from kidney thus in absence of EPO the rate of erythropoiesis by bone marrow will be minimized [21]. In addition, the role of hepacidin hormone in sequestering iron in its stores in macrophage and reducing

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iron absorption by intestine as well which thus no iron is available for erythropoiesis [6,9].
The result found that about of 62% of kidney diseases patients were suffered from hypertension [22]. Similarly, a study conducted in Tripoli observed that hypertension was the most often reported disease. Another study in North Africa found that HTN is responsible for approximately 35% of progressing of the renal problems, indicating that high blood pressure may cause damage to the kidney's blood vessels, impairing waste product discharge [18]. In United States, an increase in systolic or diastolic blood pressure, or both leads to hypertensive renal alterations and lead to CKD and eventually renal failure [18].
Although it is unclear whether HTN causes CKD or CKD causes HTN, it is well established that the two are intimately linked. In our study Diabetes Mellitus (DM) represented the second implicated factor to renal insufficiency with 40% and 37% had both hypertension and diabetes respectively. The previous studies showed that uncontrolled diabetes led to death due to coronary heart disease, blindness, and renal failure. According to WHO report that diabetes was afflicted around 422 million peoples in 2016 [18]. Our finding is in agreement with other publications found that DM and HTN are the common risk factors of kidney dysfunction and subsequent renal failure around the world [17,22].
Mean of hemoglobin for anemic patients was (10.1±0.24), while in non-anemic was 14.6±0.23)g/dl, this reduction is related to accumulation of waste products such as urea (mean (96.19±5.47mg/dl) which suppress erythropoietin production [23], and further shorten the life span of red blood cells by increasing the expression of phosphatidyl-serine on their outer surfaces enhances their recognition by splenic macrophages and accelerate RBCs destruction, finally give rise to anemia [24]. In addition to anemia, the platelet count drops only in 14% of total cases. However, this constitutes a minor change in comparing with the previous study showed that peoples with renal insufficiency are at high risk of haemorrhagic diathesis, and this indicated that megakaryocyte colony stimulating factors, acetlyhydroase (PAF-AH), and paraoxonase are potentiated by erythropoietin [16]. Moreover, erythropoietin acts as the principal humoral regulator of platelet mass, the identification of erythropoietin receptors in megakaryocytes is possible [25].
Regarding to White blood cells count, their mean in our study was 8.79±0.62, with only 18% of patients had a leucocytosis. These findings are consistent with other studies discovered that CKD patients had a slightly higher WBC count than healthy people [26], and that dialysis treatment also raises WBC counts. The presence of pro-inflammatory cytokines may be related to up-regulation of interleukin-6 (IL-6) and tumor necrosis factor (TNF) in the blood, which contributes to chronic inflammation in the uremic condition [16,27]. While Ashrafur stated that WBCs count remain unchanged during all CKDs stages [28].

Conclusion

CKD is linked to a variety of biochemical and hematological abnormalities; such metrics must be evaluated on a regular basis in CKD patients in order to minimize serious impact related morbidity and mortality. This research also aids medical scientists, young clinical pathologists, and laboratory scientists in the diagnosis of kidney disease by identifying factors detected in the blood as well as biochemical changes.

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Conflicts of Interest

There are no financial, personal or professional conflicts of interest to declare.

References

1. Kadhim HM, Al-Ghanimi HH, Al-Dedah RM. Haematological parameters and biochemical indices in patients with chronic kidney disease before haemodialysis Al-Furat Al-Awsat Governorates/Iraq. Paper presented at: AIP Conference Proceedings 2020.
2. Stauffer ME, Fan T. Prevalence of anemia in chronic kidney disease in the United States. PloS one. 2014;9(1):e84943.
3. Amin N, Mahmood RT, Asad MJ, Zafar M, Raja AM. Evaluating urea and creatinine levels in chronic renal failure pre and post dialysis: a prospective study. Journal of cardiovascular disease. 2014;2(2):1-4.
4. Evgeny Shutov WS, Ciro Esposito, Avtandil Tataradze4, Branislav Andric, Michael Reusch. et al. Roxadustat for the treatment of anemia in chronic kidney. Nephrol Dial Transplant. 2021;36:1629-1639.
5. Kaze FF, Kowo MP, Wagou IN, Maimouna M, Fouda HDMEF, Halle MP. Hematological Disorders during Chronic Kidney Disease Stages 3 to 5 Non-Dialysed in Cameroon. Open Journal of Nephrology. 2020;10: 61-72.
6. Babitt JL, Lin HY. Mechanisms of Anemia in CKD. J Am Soc Nephrol 2012;23:1631-1634.
7. Mustafa Y, Omar BL, Dhastagir SS. Haematological Changes in Predialyzed and Hemodialyzed Chronic Kidney Disease patients in Libya. Journl of Dental and Med Sciences. 2017;16(2):106-112.
8. Naeem M, et al. Biochemical changes in patients with chronic kidney failure in relation to complete blood count and anemia. International Journal of Biosciences. 2020;16(1):267-271.
9. Yacoub MF, Ferwis HF , Said F. Effect of Interleukin and Hepcidin in Anemia of Chronic Diseases. Hindawi. 2020:(1):3041738.

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10. Eschbach JW. The anemia of chronic renal failure Pathophysiology and the. Kidney International. 1989;35:134-148.
11. Akinola OI, Hannah O, Agaba Emmanue I. Anemia and its predisposing factors In pre-Dialysis Chronic kideny. Jos Journal Of Medicine. 2018;12(2):15-23.
12. Marie E, et al. Contemporary management of anaemia, erythropoietin resistance and cardiovascular risk in patients with advanced chronic kidney disease: a nationwide analysis. Clinical kidney journal. 2020;13(5):821-827.
13. Ijoma C, Ulasi I, Ijoma U, Ifebunandu N. High prevalence of anemia in predialysis patients in Enugu, Nigeria. Nephrology Research & Reviews. 2010;2(1):61-65.
14. Mehdi U, Toto RD. Anemia, diabetes, and chronic kidney disease. Diabetes care. 2009;32(7):1320-1326.
15. Locatelli F, et al. Clinical practice guidelines for anemia in chronic kidney disease: problems and solutions. A position statement from Kidney Disease: Improving Global Outcomes (KDIGO). Kidney international. 2008;74(10):1237-1240.
16. Anwar Habib RA, Sana Rehman. Hematological changes in patients of chronic renal failure and the effect of hemodialysis on these parameters. International Journal of Research in Medical Sciences. 2017;5(11):4998-4500.
17. Hansberry MR, Whittier WL, Krause MW. The elderly patient with chronic kidney disease. Advances in chronic kidney disease. 2005;12(1):71-77.
18. Habas E, Elamouri J, Rayani A. Chronic kidney disease in Libya, cross-sectional single center study. Epidemiology (Sunnyvale). 2016;6(5):2-4.
19. Amoako YA, Laryea DO, Bedu-Addo G, Andoh H, Awuku YA. Clinical and demographic characteristics of chronic kidney disease patients in a tertiary facility in Ghana. The Pan African Medical Journal. 2014;18.
20. Wokoma FS, Emem-Chioma PC. Prevalence of Anaemia and other Haematologic Derangements in End Stage Renal Disease Patients in the University of Port Harcourt Teaching Hospital. Tropical Journal of Nephrology. 2009;4(2):107-107.
21. George C, Matsha TE, Erasmus RT, Kengne AP. Haematological profile of chronic kidney disease in a mixed-ancestry South African population: a cross-sectional study. BMJ open. 2018;8(11):e025694.
22. Al-taworghei AH, Al-saqer ES, Erhoma EA, Sabei LT, Abukres SH. Chronic Kidney disease among a sample of Libyan population: What are the leading Risk Factors?. Lebda Medical Journal. 2019;6(1):221-224.
23. Lesley G, et al . Anemia of Chronic Renal Failure in Dogs. Veterinary of Intenal Medicine. 1992;5(6):264-270.
24. MR J. Acquired nonimmune hemolytic disorders. Wintrobe's Clinical Hematology. 2003.
25. Yenicerioglu Y, et al. Effects of haemodialysis on pulmonary clearance of Tc-99m diethylene triamine pentaacetate (DTPA). Scandinavian journal of urology and nephrology. 2000;34(2):126-130.
26. Alghythan AK, Alsaeed AH. Hematological changes before and after hemodialysis. Scientific Research and Essays. 2012;7(4):490-497.
27. Portolés J, Martine L, Broseta JJ, and Case A. Anemia in Chronic Kidney Disease: From Pathophysiology and Current Treatments, to Future Agents. Frontiers in Medicine. 2021;8:1-14.
28. Rahman MA, et al. Hematological Abnormalities and Comorbidities Are Associated With the Severity of Kidney Disease: A Hospital-Based Cross-Sectional Study in Bangladesh. Clinical Pathology. 2022;15:1-10.

المستخلص

مرض الكلى المزمن يعتبر من المشاكل الصحية الخطيرة التي قد تؤدي المرحلة النهائية (الغسيل الكلوي)، تلك المرضى عادة ما يصاحبهم فقر الدم الذي بدوره قد يؤدي الى عواقب وخيمة مثل امراض القلب والاوعية الدموية وضعف القدرة على التركيز، هدفت هذي الدراسة الى تقييم التغيرات في نسب الدم ومعاملاته الاخرى لدى الاشخاص المصابين بأمراض الكلى قبل مرحلة الغسيل الكلوي في مدينة البيضاء. شملت الدراسة 107 مريضا في وحدة امراض الكلى في مركز البيضاء الطبي خلال الفترة من شهر نوفمبر 2021 الى مارس 2022 شملت الدراسة جميع مراحل القصور الكلوي المزمن ولم يكونوا على الغسيل الكلى وتم الحصول على البيانات عن طريق المقابلة الشخصية مع المرضى وملفات السجلات وتم سحب عينات الدم ((EDTA blood لقياس صورة الدم الكاملة ((CBC بما فيها نسبة هيموجلوبين ومتوسط حجم خلايا الدم الحمراء ومتوسط الهيموجلوبين الخلوي وعدد الصفائح الدموية وكريات الدم البيضاء بالإضافة الى قياس وظائف الكلى(اليوريا والكرياتينين) وتم تحليل النتائج عن طريق برنامج احصائي ولقد اظهرت النتائج انا من اصل 107 مريضا كان 41.1 (44%) منهم الذكور و 58.8 (63%) هم من الاناث وكانت نسبة انتشار انيميا 45.8% وكان لدي غالبية المرضى يعانون من امراض اخرى مزمنة قد تكون هي السبب الرئيسي- المسبب لمرض الكلى حيث حوالي 62% لديهم ارتفاع في الضغط الدم و40% لديهم مرض السكري. وكان هناك فروق معنوية في متوسط الهيموجلوبين والهيماتوكريت بين المشاركين الذين لديهم انيما عن الاشخاص الاصحاء (قيمة الاحتمالية0.000) اما احجام خلايا الدم الحمراء فكانت المؤشرات طبيعة. 14% من المرضى كان يعانون من ارتفاع عدد خلايا الدم البيضاء و 18% كان لديهم نقص في الصفائح الدموية. اخيرا يمكننا القول بان انيميا المتعلقة بمرض الكلى المزمن لها مضاعفات خطيرة قد تقلل من جودة الحياة اليومية ويتطلب متابعة دقيقة لتقليل من عوامل خطر الامراض المصاحبة.

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