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Assessment of creatinine and blood urea in kidney failure patient within Kerkuk city, Iraq

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Abstract

The assessment of creatinine, a waste product produced by muscle metabolism that is filtered out of the body by the kidneys and the levels of blood urea are important tools for monitoring kidney's function. A total of 191 patients (105 male and 86 female) encountered in this study, with kidney failure compared with 21 control healthy individuals (11 male and 10 female). A significant increase ($p \leq 0.0012$) in creatinine was detected in kidney failure patients (9.3±3.2) in comparison with control (0.62±0.1) as well as between the genders. In female the creatinine level was significantly higher ($p \leq 0.05$) than that of male. The general levels of urea have also elevated in kidney failure disease (KFD) from (112±42) in comparison with control (25±10) but with a slight significant difference ($p \leq 0.05$) between the genders. The percentages of Hb% showed a significant decrease ($p \leq 0.007$) in kidney failure patients in comparison with control of all cases. Similarly, the packed cell volume (PCV) had significantly dropped down ($p \leq 0.01$) in total patients as well as in between genders in comparison with their counter control. Increased urea 4-5 folds in kidney patients confirms, to certain extend, the occurrence of dysfunction of kidneys and failure to re-absorb the nitrogen components leading to elevation of its amount in patients. Regular monitoring of creatinine and blood urea levels, along with other factors deems essential for improving patient health and quality of life.

Keywords: Biochemistry; Blood urea; Creatinine; Kerkuk; Kidney failure.

1. Introduction

Kidney failure (renal failure), is a medical condition where the kidneys are no longer able to function properly, no longer adequately filter waste products from the blood, or, functioning at a rate less than 15% of normal levels [1]. Kidney dysfunction is classified as either acute kidney failure (AKF), that develops rapidly, though, resolvable; and chronic kidney failure (CKF), that develops slowly but can often be irreversible [2]. Symptoms may include leg swelling, feeling tired, vomiting, loss of appetite, and confusion [3]. Complications of both acute and chronic failure include uremia, hyperkalaemia, and volume overload [4]. However, complications of chronic failure also include heart disease, hypertension and anemia [5]. Causes of AKF include hypotension, blockage of the urinary tract, certain medications, muscle breakdown, and hemolytic uremic syndrome while causes of CKF include diabetes, hypertension, nephrotic syndrome, and polycystic kidney disease [2]. Diagnosis of AKF is often based on a combination of factors i.e. decreased urine production or increased serum creatinine while diagnosis of chronic failure is based on a glomerular filtration rate (GFR) of less than (<15) or the need for renal replacement therapy that is equivalent to stage 5 chronic kidney disease [1]. Differences between AKF and CKF further extends e.g. treatment of AKF depends on the underlying causes meanwhile treatment of CKF may include hemodialysis, peritoneal dialysis, or a kidney transplant [6]. Other recommended measures from chronic disease include staying active and specific dietary changes [7][8]. Some patients; however, with appropriate treatment many patients with chronic disease can continue

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working [10]. Other causes of kidney failure may include diabetes, hypertension, various kidney, e.g. glomerulonephritis, and interstitial nephritis, infections, i.e. pyelonephritis, certain medications e.g. nonsteroidal anti-inflammatory drugs (NSAIDs), trauma to the kidneys, obstruction in the urinary tract, autoimmune diseases: i.e. lupus and vasculitis, congenital abnormalities, i.e. polycystic kidney disease[9].

Overall, the kidney failure is a serious medical condition that can have many different causes. Early diagnosis and treatment are important for managing the condition and preventing further damage to the kidneys. Renal insufficiency (kidney insufficiency), a medical condition where the kidneys are not able to function properly can be identified through several diagnostic tests and examinations determine the extent of the disability i.e. blood tests, urine tests imaging tests and biopsy to identify renal insufficiency. The severity of renal insufficiency, typically classified using the glomerular filtration rate (GFR), which indicates how well the kidneys are filtering waste from the blood where a GFR of <60 mL/min/1.73m^2 for 3 months or more implies chronic kidney disease (CKD) [11]. Creatinine is removed from the blood primarily by glomerular filtration via proximal tubular secretion too. However, little or no tubular re-absorption of creatinine may occur. Hence, whenever filtration in the kidney is deficient, blood creatinine concentrations rise in the urine and blood. Accordingly, creatinine concentrations in blood and urine are used to calculate the creatinine clearance (CrCl), which correlates approximately with the glomerular filtration rate (GFR) [12]. The normal range of creatinine levels varies based on age, gender, and muscle mass e.g. men is 0.6-1.2 mg/dL (53-106 μmol/L) and for women is 0.5-1.1 mg/dL (44-97 μmol/L). Higher than normal creatinine levels may indicate kidney dysfunction or failure.

Some tests are commonly used to diagnose and monitor kidney function e.g. blood tests which measures the level of creatinine and blood urea nitrogen (BUN) where levels of creatinine and BUN increase denoting the dysfunction of kidney. Meanwhile, urine test can detect the presence of protein or blood in the urine as a sign of kidney damage or disease too. These testes may be considered costly, yet, are worthy. Serum creatinine is an important indicator of kidney health, too, because it is an easily measured byproduct of muscle metabolism that is excreted unchanged by the kidneys [13]. Creatinine, represents the breakdown product of creatine phosphate from muscle and protein metabolism where it is produced and released at a constant rate by the body, depending on muscle mass. Kidney patients are so common in Kerkuk province but statistical data are so scanty.

2. Materials and Methods:

A total of 191 patients (105 male and 86 female) are encountered in this study. The patients are advised to fast for 8-12 hours before the test. Blood samples, are collected using sterile needle from the periphery vein. The blood samples were analyzed at private laboratory by separating the sera from the other components using a 3,000/minutes rotation centrifuge. Creatinine levels were measured using "Jaffe reaction", enzymatic assays, and high-performance liquid chromatography (HPLC). The intensity of the color is proportional to the amount of creatinine present in the sample in milligrams per deciliter (mg/dL) or micromoles per liter (μmol/L).

The test procedure adopted by Tao, *et al.,* (2007) [14], was used to evaluate kidney function and to diagnose or monitor conditions that affect the kidneys. Samples were labeled with names on, date of birth, and other identifying information. The samples are then sent to the laboratory for analysis to measure the amount of urea nitrogen in the blood. Results were reported in milligrams per deciliter (mg/dL) or millimoles per liter (mmol/L). Normal blood urea nitrogen levels range from 7-20 mg/dL (2.5-7.1 mmol/L), but may vary depending on age, gender, and other factors.

3. Results

Generally, a significant increase ($p \leq 0.001$) was detected in kidney failure patients (9.3±3.2) in comparison with control (0.62±0.1) as well as between the genders. In female the creatinine level was significantly higher ($p \leq 0.05$) than that of male. Levels of urea has also been, elevated from KFD patients in comparison with control but showed slight significant differences between the genders (Table -1). The percentages of Hb% showed a significant decrease ($p \leq 0.007$) in kidney failure patients in comparison with control of all cases. Similarly, the packed cell volume (PCV) had significantly ($p \leq 0.01$) dropped down in total patients as well as in between genders in comparison with their counter control.

Table 1 The arithmetic means of parameters include creatinine, Urea, Hb% and PCV with their ±sd and probability tests. Number of asterisks (* or **) denotes the standard of significances.

Samples/No& T-Test	Creatinine±Sd (mg/dL)	Urea ± Sd (mmol/L)	Hb±Sd (g/dL)	PCV±Sd (%)
Patients (n=191)	9.3±3.2	112±42	7.8±2.3	28±13.4
Control (n=21)	0.1±0.62	25±10	10.1±2.3	36±4.1
Probability test ($p \leq 0.05$)	0.0012**	0.009*	0.0071*	0.010*
Patients/Male (n=105)	6.2±3.7	110±38	7.5±5.2	24.5±14.3
Control/Male (n=11)	0.83±0.2	30.7±11	12.1±3.2	37.5±4.1
Probability test ($p \leq 0.05$)	0.0014	0.06	0.006*	0.0045*
Patients/Female (n=86)	9.1±4	114 ±4.5	8.1±1.7	28±8.5
Control/Female (n=10)	0.6±0.3	26±10	10±1.3	31±7
Probability test ($p \leq 0.05$)	0.0021**	0.05	0.0017**	0.0014**

The number of leukocytes (WBCx10^9)/mL as well as the blood platelets were incomparable in kidney failure patients versus the control as well as between genders themselves (Table-2). However, blood platelets (PLT) showed a slight and an insignificant changes.

Table 2 The arithmetic means of parameters include creatinine, Urea, Hb% and PCV with standard deviation (±sd) and probability tests results. (NS) insignificant differences ($p > 0.05$)

Samples/Numbers	WBC±Sd (x10^9)	PLT ± Sd (x/mL)
Patients (n=191)	8.9±3.2	226±60
Control (n=21)	8.6±0.1	225±34
$p \leq$	0.05	0.10^{NS}
Patients/Male (n=105)	11.2±4.3	250±67
Control/Male (n=11)	7.3±2.2	228±32
$p \leq$	0.05	0.07^{NS}
Patients/Female (n=86)	7.9±2	197±75
Control/Female (n=10)	7.4 ±3	218±37
$p \leq$	0.06	0.10^{NS}

4. Discussion

Measurement of some blood parameters in patients with kidney failure e.g. creatinine, urea, WBC, Hb% and PLT have been approved indicative tools to assess the health condition of patients. Measuring serum creatinine is a simple test, and is the most commonly used indicator of renal function as it represents an important indicator of kidney health, due to an easily measured byproduct of muscle metabolism that is excreted unchanged by the kidneys [15]. Several interpretation of increased serum creatinine have been postulated i.e. increased ingestion of cooked meat, an intense exercise could lead to an increase creatinine by increasing muscle breakdown whereas, dehydration secondary to an inflammatory process with fever may cause a false increase in creatinine concentrations not related to an actual kidney injury as well as several medications and chromogens can interfere too with the assay [16]. A lower serum creatinine concentration was found to be associated with an increased risk for the development of type-2 diabetes in Japanese men [17]. Diagnostic serum creatinine studies, are used to determine renal function where the reference interval is 0.6-

1.3 mg/dL (53-115 μmol/L). Creatinine secretion by the tubules is blockable by some medications, again increasing measured creatinine [16]. Accordingly, several reasons and consequent interpretation of etiology might be associated with the kidney failure one should take into account when interpreting the results. In the present research, creatinine secretion has dramatically elevated in kidney failure patients which confirm dysfunction of kidney, mal-absorption of proteins by proximal convoluted tubules or else. Elevation of creatinine was significantly higher in male in comparison with female patients. Such a difference might be due to higher susceptibility of male to kidney failure than female due to their relatively extra muscular activity, in comparison with female where more protein is broken down.

A better estimation of kidney function is given by calculating the estimated glomerular filtration rate (eGFR) which can be accurately calculated without a 24-hour urine collection using serum creatinine concentration and some or all of the following variables: gender, age, weight, and race, as suggested by the American Diabetes Association (ADA). Many laboratories will automatically calculate eGFR when a creatinine test is requested. The glomerular filtration rate (GFR) deems clinically important as a measurement of kidney function quality where at severe kidney dysfunction while, the creatinine clearance (CrCl) rate may overestimate the GFR because hypersecretion of creatinine by the proximal tubules will account for a larger fraction of the total creatinine cleared [18].

Blood urea levels can also be influenced by factors i.e. diet and hydration status, which can vary between men and women. Men may be more likely to develop certain types of kidney disease i.e. polycystic kidney disease, which can contribute to higher levels of creatinine and blood urea. Elevation of WBC, in any case, refers to infection and an unhealthy condition e.g. leukocyte count above 25-30×10^9/L is termed a *leukemoid reaction*, i.e. the reaction of a healthy bone marrow to extreme stress, trauma, or infection. It is different from leukemia and from leuko-erythroblastosis, in which either immature WBC (acute leukemia) or mature, yet non-functional, WBC (chronic leukemia) are present in peripheral blood [19]. While leukocytosis is very common phenomenon in acutely an unwell individual details of types of WBC cells should also be differentially counted to analyze the source of infection [20]. It occurs in response to a wide variety of conditions, including viral, bacterial, fungal, or parasitic infection, cancer, hemorrhage, and exposure to certain medications or chemicals including steroids. However, it is important to note that there can be significant individual variation in these biomarkers, and other factors i.e. age, weight, and overall health status can also play a role in compromising the results. For lung diseases i.e. pneumonia and tuberculosis, the WBC count is very important for diagnosis of the disease. The mechanism that causes leukocytosis can be of several forms e.g. an increased release of leukocytes from bone marrow storage pools, decreased margination of leukocytes onto vessel walls, decreased extravasation of leukocytes from the vessels into tissues, or an increase in number of precursor cells in the marrow [19]. While an extreme form of leukocytosis, where the WBC count exceeds 100,000/μL, is leukocytosis; however, a slight increase, ranged between insignificant to low significant, has been noted in the kidney damaged patients may attribute to a slight effects on body; or that body had adapted itself with current kidney failure condition by the time. Differential counting would have been necessary to be encountered in this study but was, unfortunately, not done.

While hemoglobin carries oxygen (O_2) from the respiratory organs e.g. lungs to other tissues of the body to enable aerobic respiration powers the metabolism. A healthy human has 12-20 grams of hemoglobin in every 100 mL of blood. Common causes of low hemoglobin include loss of blood, nutritional deficiency, bone marrow problems, chemotherapy, kidney failure, or abnormal hemoglobin [21]. In the present research a slightly significant drop in Hb% was noticed denoting a decline in its capacity in transporting O2 in the body, and consequence functions. Such a decline in gas transport may well attribute to dysfunction of globin protein production in bone marrow in kidney failure patients [22].

Although, the normal number of platelets (PLT) in the blood ranges between 150,000-400,000/microliter (mL) or 150-400×10^9/L, may slightly vary from laboratory to another. Some laboratories use different measurements or may test different specimens. The insignificant change in number of PLT in kidney failure patients may indicate no impact of the kidney disorder on PLT nor to its normal three functions e.g. hemostasis, thrombosis, and wound healing and in blood clotting risk inside the blood vessels. Although, blood urea nitrogen (BUN) test that measures the amount of nitrogen in the blood comes from urea, used as a marker of renal function, yet it is inferior to other markers i.e. creatinine because blood urea levels are influenced by other factors i.e. diet, dehydration and liver function [23]. Increased urea 4-5 folds in kidney patients in this study confirms, to certain extend, the occurrence of dysfunction of kidney and its failure to re-absorb the nitrogen components leading to elevation of its amount in the patients.

5. Conclusion

Increased urea 4-5 folds in kidney patients in this study implies dysfunction of kidneys and failure to re-absorb the nitrogen components leading to kidney failure. Regular monitoring of both creatinine and blood urea levels, along with other factors deems essential as a routine health check for public.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest that would prejudice the impartiality of this scientific work.

Statement of ethical approval

All test carried out in this research are in accordance with ethical code and no private data of patients are disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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