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REVIEW ARTICLE

Estimation of serum electrolytes and renal function in patients with kidney failure in Mosul city

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Abstract:

Background: Renal failure, additionally referred to as kidney failure, is an illness in which the kidneys are unable to filter bodily waste from circulation. This can cause an accumulation of harmful substances and electrolytes in the human body, which can result in a variety of unpleasant side effects. Electrolytes are minerals that are essential for proper body function, including maintaining fluid balance, regulating nerve and muscle function, and supporting heart health. Imbalances in electrolyte levels can occur in individuals with kidney failure due to the kidneys' inability to regulate electrolyte levels properly. Objectives: The purpose of this study is to determine the approximate levels of chloride, sodium, potassium, calcium, and magnesium in individuals with kidney failure. Materials and methods: 50 dialysis patients from Ibn Sina Teaching Hospital/Dialysis Unit in Al-Mosul, Iraq, aged 18–77, were studied from October 2021 to January 2022. Controls were 50 physically healthy people. They were 19–75. Blood sampling and biochemical analysis were performed. Results: This study examined the differences in age and gender groups and electrolyte levels between individuals with kidney failure and healthy controls. The findings revealed no statistically significant differences in age and gender distribution between cases and controls. However, observable differences were significant in the levels of electrolytes between cases and controls, with increased levels of potassium, magnesium, and phosphate and decreased levels of sodium, calcium, and chloride in individuals with kidney failure. Conclusion: This study suggests that regular monitoring of electrolyte levels and implementing interventions to correct electrolyte imbalances, as well as early detection and management of kidney disease, may help prevent the progression of kidney failure. Further study is required to investigate the relationship between electrolyte imbalances and kidney disease in further explanation.

Keywords: Electrolytes, renal function, kidney failure, dialysis.

Introduction

The When kidney function drops to a value lower than 15% of normal, a medical condition known as renal failure takes place (1). Acute kidney failure occurs suddenly and may improve; chronic kidney failure takes longer to manifest and is generally irreversible. Leg swelling, fatigue, nausea, loss of appetite, mental fogginess, and confusion are all possible symptoms. Uremia, elevated blood potassium, and overload of volume are all conditions that can arise as a result of acute or chronic failure. Heart disease, elevated blood pressure, and anaemia are also associated with chronic failure (2).

Acute kidney failure can result from a number of different conditions, including hypotension, urinary tract blockages, pharmaceutical side effects, breakdown of muscles, and a condition called hemolytic uremic syndrome. Hypertension, diabetes, a condition called nephrotic syndrome, and polycystic kidney disease are some of the root causes of kidney failure that lasts a long time. Acute failure is often diagnosed using a combination of indicators, including abnormally low urine output and high serum creatinine levels (3). About 3 out of every 1,000 Americans will experience acute failure each year. About 1 in 1,000 people have chronic failure, and 3 out of every 10,000 people each year will develop the illness. Many people with chronic illnesses can keep working with the right care (3). A glomerular filtration rate (GFR) of less than 15 or the requirement for renal replacement therapy constitutes a diagnosis of chronic failure (4). Renal failure and cardiovascular disease are just two of the many health issues that can arise from chronic renal failure (5).

Kidney disease is more prevalent in those aged 20 and up and has already reached epidemic proportions in several parts of the world. In 2010, there were 225.7 million men and 271.8 million women worldwide who were renal failure patients. Recent studies show that kidney failure affected 697.5 million people worldwide in 2017. Kidney failure was more common in females (9.5% of cases) than in males (7.3%) (6). Ten nations had more than 10 million instances, while 79 countries had more than 1 million cases of renal failure. About a third of all

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cases were in China (132.3 million) and India (115.1 million) (7, 8).

Rehabilitation is essential due to the prevalence of renal failure and the difficulties faced by dialysis patients. Kidney failure patients face a wide range of mental and physical difficulties as well. Dialysis is a difficult operation, and while saving the patient's life is the primary objective, increasing the patient's health-related quality of life is equally important (8). Electrolytes, often known as ions, are a vital component that serves several important purposes in the body. Some of the many metabolic and homeostatic roles played by the macro or major electrolytes—sodium, potassium, calcium, magnesium, chloride, and phosphorus—include enzymatic reactions, bone mineralization, nerve impulse conduction, muscle contraction, and osmotic balance regulation. Maintaining healthy levels of these substances is essential for optimal bodily function (9).

Renal physiology can also be assessed by measuring electrolyte abnormalities, which are a quantifiable serum biochemical marker. Patients with chronic kidney disease (CKD) who undergo regular dialysis or a kidney transplant will have their severe biochemical derangements normalized. In addition, several nutritional supplementation therapies can be tailored to reduce the risk of electrolyte derangement problems in CKD patients. In Pakistan, the number of people living with CKD continues to rise. Proper diagnosis and treatment can reduce the risk of complications and even save lives. Recent research has examined the disarray of blood biochemicals in CKD patients. This includes serum electrolytes, glucose, albumin, and indicators of renal function. Hyperuricemia risk factors are also assessed. (10). Current project aims to estimate chloride, sodium, potassium, calcium, and magnesium in kidney failure patients.

Materials and Methods

Patients and Control samples

The study was done during the period of (five October 2021 to five January 2022) on (50) dialysis patients in Ibn Sina Teaching Hospital / Dialysis Unit/ Al-Mosul/ Iraq. Their ages ranged between (18-77) years. Fifty physically healthy individuals were chosen to serve as a control group. Their ages ranged between (19-75) years.

Blood Samples collection and Biochemical Analysis

Disposable 5 ml syringes were used to draw blood from the participants. The blood samples were then centrifuged at 3000 rpm for 15 minutes. After centrifugation, serum was collected and stored in Eppendorf tubes at -20 degrees Celsius for later use in a biochemical analysis. Serum electrolytes (Na+, K+, Ca+2, Mg+2, Cl-, and P4-3) and indicators of renal function (urea and creatinine) were measured.

Statistical analysis

The data underwent an analysis of variance, and the significant differences at P≤0.05 were assessed by ANOVA, one-way by utilizing the statistical software's sigma statistical.

Results

Distribution of age groups according to the studied groups:

The data in table (1) showed three categorical age groups: (18-37) years old include 12 (34.3%) with kidney failure and 23 (65.7%) were controls. (38-57) years old include 18 (48.7%) with kidney failure and 19 (51.3%) were controls, and (58-77) years old include 20 (71.4%) with kidney failure and 8 (28.6%) were controls. These differences, statistically, were non-significant (P-value=0.0126).

Distribution of gender groups according to the studied group:

The results presented in Table (2) reveal that 50 cases (50%) and 50 controls (50%) from a total of 100 (100%) individual samples were 22 females (44%) with kidney failure and 21 females (41%) were controls. On the other hand, 28 males (56%) with kidney failure and 29 males (58%) were controls, in which the statistically significant difference was non-significant (P-value= 0.1568).

Comparison Levels of electrolytes elements between case and control groups:

The results illustrated in table (3) indicate that the levels of electrolytes elements were variable among cases ofkidney failure and control (healthy individuals), which indicated by significant increase the levels of mean and SD of Potassium (K+) (mmol/L), Magnesium (Mg+2) (mg/dl), and Phosphate (PO4-3) (mg/dl), among cases (5.36±0.83), (3.83±0.84), and (5.93±2.11) respectively as compared with control, whereas significant decrease the levels of mean and SD of Sodium (Na+) (mmol/L), Calcium (Ca+2) (mg/dl), and Chloride (Cl) (mmol/L) among cases (126.08±12.81), (7.12±1.37), and (97.52±9.10) as compared with control, Statistically this difference was highly significant (P-value=0.01).

Comparison Levels of Creatinine, Urea, and Iron between case and control groups:

The results in table (4) indicated a significant increase in the levels of mean and SD of creatinine (mg/dl) and urea (mg/dl) among cases (9.75±4.50), and (112.50±36.83) respectively as compared with the control, whereas a significant decrease in the levels of mean and SD of sodium (Fe) (µg/d) among cases (58.52±34.08) as compared with the control. Statistically, these differences were highly significant (P-value=0.01).

Table (1): Distribution of age groups according to the studied groups

Categorical age group (Years)		Study Groups Case	Study Groups Control	Total	*P-value
(18-37)	N	12	23	35	0.0126
	%	34.3%	65.7%	35%	
(38-57)	N	18	19	37	
	%	48.7%	51.3%	37%	**(N.S)
(58-77)	N	20	8	28	
	%	71.4%	28.6%	28%	
Total	N	50	50	100	
	%	50%	50%	100%	

*.Chi-square test;**; N.S; non-significant

Table (2): Distribution of gender groups according to the studied groups

Categorical gender group		Study Groups Cases	Study Groups Control	Total	*P-value
Female	N	22	21	43	0.1568
	%	44%	41%	43%	
Male	N	28	29	57	
	%	56%	58%	57%	**(N.S)
Total	N	50	50	100	
	%	50%	50%	100%	

*Chi-square test;**; N.S; non-significant.

Table (3): Levels of electrolyte elements between case and control groups.

Electrolytes Elements	Study Groups	N	Mean±SD	*t-test	P-Value
Na^{+} (mmol/L)	Case	50	126.08±12.81 b	3.767	** H.S.
	Control	50	139.92±3.99 a		
K^{+} (mmol/L)	Case	50	5.36±0.83 a	0.276	** H.S.
	Control	50	4.06±0.51 b		
Ca^{+2} (mg/dl)	Case	50	7.12±1.37 b	0.413	** H.S.
	Control	50	9.37±0.54 a		
Mg^{+2} (mg/dl)	Case	50	3.83±0.84 a	0.258	** H.S.
	Control	50	1.81±0.35 b		
Cl (mmol/L)	Case	50	97.52±9.10 b	3.139	** H.S.
	Control	50	106.58±6.49 a		
PO_4^{-3} (mg/dl)	Case	50	5.93±2.11 a	0.617	** H.S.
	Control	50	3.39±0.60 b		

*Independent-sample T test, **highly-significant, SD: Standard Deviation

Table (4): Renal function and iron parameters between case and control groups.

Parameters	Study Groups	N	Mean±SD	*t-test	P-Value
Creatinine	Case	50	9.75±4.50 a	1.266	** H.S.
	Control	50	0.91±0.24 b		
Urea	Case	50	112.50±36.83 a	10.66	** H.S.
	Control	50	28.34±9.37 b		
Fe	Case	50	58.52±34.08 b	12.58	** H.S.
	Control	50	107.76±29.13 a		

*Independent-sample T test, **highly-significant, SD: Standard Deviation

Conclusions

In conclusion, this study compared kidney failure patients and healthy controls across age, sex groups, and electrolyte levels. In this study, it was observed no statistically significant variation in the distribution of cases and controls based on gender and ages. However, individuals with renal failure had significantly higher levels of potassium, magnesium, and phosphate and lower levels of sodium, calcium, and chloride compared to the control group. These results point towards a potential role for electrolyte abnormalities in the onset and progression of renal failure. To better understand this connection and to locate therapies that can help prevent or treat renal failure, more study is required.

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Conflict of interests

There are no competing interests, according to the authors.

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