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Assessment of Renal Functions among Sudanese Patients with Acute Lymphoblastic Leukemia's Receiving Chemotherapy in Radiation and Isotopes Center of Khartoum (RICK), Sudan

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Background: A wide array of disturbances in electrolyte equilibrium is commonly seen in patients with acute leukemia (AL). These abnormalities present a potential hazard in these patients, as that of enhancing the cardio-toxic effects of certain chemotherapeutic regimens.
Materials and Methods: This study was designed as interventional study, which includes 50 samples, the data was collected form hospital archives, include both male and female (the males is 24 with 48% while the rests 26 is females with 52%), from different area in Sudan (east is 2%, west is 64%, north is 10%, south is 12%, and center is 12%), have different classification of Acute Lymphoblastic Leukemia's (L1 is 17 with 34%, L2 is 27 with 54% and L3 is 6 with 12%). Carried out in Radiation and Isotopes Center of Khartoum in Khartoum state, during the period from February 2020 to January 2021, and the obtained data were analyzed by SPSS.
Results: The result of this study showed that there was insignificant difference ($p>0.05$) in the serum levels of urea, creatinine, uric acid, sodium, calcium, phosphorous, and magnesium in the study groups before and after treatment, and significant increase in the serum level of potassium in the study groups after treatment p. value of 0.007, the mean of serum level of potassium before and after treatment is 2.688 and 3.702 respectively. And insignificant difference ($p>0.05$) in the serum levels of urea, creatinine, uric acid, sodium, calcium, phosphorous, potassium and magnesium in the study groups before and after treatment according to gender and FAB classification.
Conclusion: The study conclude that the serum levels of urea, creatinine, uric acid, sodium, calcium, phosphorous, and magnesium was not affected by treatment, but the potassium is increased after treatment. And the gender and classification of Acute Lymphoblastic Leukemia's have insignificant effect on the serum levels of urea, creatinine, uric acid, sodium, calcium, phosphorous, potassium and magnesium.

Keywords: Acute Lymphoblastic Leukemia's; urea; creatinine; uric acid; sodium; potassium; calcium; magnesium; phosphorous, Sudanese.

1. INTRODUCTION

"The kidneys are vital organs that perform a variety of important functions, homeostasis (maintenance of equilibrium) of the body's water, electrolyte and acid base status, and participation in hormonal regulation" [1].

"Acute lymphoblastic leukemia (ALL) is a cancer of the lymphoid line of blood cells characterized by the development of large numbers of immature lymphocytes. Symptoms may include feeling tired, pale skin color, fever, easy bleeding or bruising, enlarged lymph nodes, or bone pain. As acute leukemia, ALL progresses rapidly and is typically fatal within weeks or months if left untreated, and it is the most common type of leukemia in young children" [2]. "Acute myeloid leukemia (AML): which affect myeloid cells and grows quickly, hepatic involvement in acute leukemia's is usually mild and silent at the time of diagnosis" [3]. "Some study showed liver infiltration in 95% of ALL and 75% of AML patients" [4]. "In ALL, infiltration was confined to the portal tract, whereas in AML, infiltration was observed in both portal tract and sinusoids, massive leukemic cells infiltration of the liver may present as a fulminant hepatic failure" [5]. "The aminotransferases are normally present in the serum in low concentration; these enzymes are released into the blood in greater amounts when there is damage to the liver cell membrane resulting in increased permeability" [6]. "The activation of ALP and GGT are elevated in hepatic infiltration by leukemic cells" [7].

"In acute lymphocytic leukemia, renal complications occur due to several factors, including leukemic infiltration of the kidneys, therapy-related side effects such as tumor, nephrotoxic drugs, and septicemias" [8]. "Hyperuricemia, as a manifestation of tumor lysis syndrome, is a well-recognized complication and in most cases, it occurs after the initiation of chemotherapy. The most common symptoms in children are easy bruising, pale skin, fever, and an enlarged spleen or liver" [9-11].

2. MATERIALS AND METHODS

This is a facility based, interventional study, which includes fifty samples, the data was collected form hospital archives, include both male and female (the males is 24 with 48% while the rests 26 is females with 52%), from different area in Sudan (east is 2%, west is 64%, north is

10%, south is 12%, and center is 12%), have different classification of Acute Lymphoblastic Leukemia's (L1 is 17 with 34%, L2 is 27 with 54% and L3 is 6 with 12%).

Carried out in Radiation and Isotopes Center of Khartoum in Khartoum state, during the period from February 2020 to January 2021, and the obtained data were analyzed by SPSS.

2.1 Study Area

This study was conducted in Khartoum state at Radiation and Isotopes Center of Khartoum (RICK), is the largest hospital in Sudan and infective patients from all the century.

2.2 Study Population

Participants involved in this study were Sudanese patients with Acute Lymphoblastic Leukemia's for different classification of Acute Lymphoblastic Leukemia's, and including both males and females from different area in Sudan, attending the Radiation and Isotopes Center of Khartoum (RICK).

2.3 Data Collection

Data was collected form hospital archives.

2.4 Sampling Technique

Simple random sampling technique was used to enrolled participants in this study.

2.5 Statistical Analysis

Collected data was computed and analyzed using the SPSS (statistical package for social sciences) software program; version 21. Independent 'T. test' was used for comparison (p-value of ≤ 0.05) was consider significant.

3. RESULTS

This study was designed as interventional study, conducted in Khartoum state in Radiation and Isotopes Center of Khartoum (RICK), to assess the renal functions among Sudanese patients with Acute Lymphoblastic Leukemia's Receiving Chemotherapy. The study include 50 samples, the participants included from different area in Sudan; east is 2%, west is 64%, north is 10%, south is 12%, and center is 12%, that illustrated in Table (1).

The patients is divided into two groups before and after treatment, then the levels of urea, creatinine, uric acid, sodium, calcium, phosphorous, potassium and magnesium is compared between them, and statistically showed insignificant difference between the levels of urea, creatinine, uric acid, sodium, calcium, phosphorous and magnesium (p. value less than 0.05), and the potassium is significantly increased after the treatment, that illustrated in Table (2).

The patients have different classification of Acute Lymphoblastic Leukemia's (L1 is 17 with 34%, L2 is 27 with 54% and L3 is 6 with 12%), and classified into two groups (before and after treatment) for each classification of ALL, and the study showed statistically insignificant difference between the parameters for each classification of ALL (p. value less than 0.05), that illustrated in Tables (3), (4) and (5).

The study include both males and females, the males were 24 with 48% while the rests 26 were females with 52%, and the levels of parameter is compared between them, and showed statistically insignificant difference (p. value less than 0.05), that illustrated in Table (6).

Table 1. Show the geographical distribution of Acute Lymphoblastic Leukemia's

Area	Frequency	Percent
East	1	2
West	32	64
North	5	10
South	6	12
Center	6	12
Total	50	100

Table 2. Comparison of renal parameters among study population before and after treatment

Parameters	Before (Mean ± SD)	After (Mean ± SD)	p. value
Urea	(49.54±28.423)	(50.28±36.913)	0.538
Creatinine	(1.730±0.964)	(2.388±2.120)	0.717
Uric Acid	(3.160±1.152)	(5.744±2.594)	0.078
Calcium	(8.645±0.906)	(10.803±12.280)	0.182
Phosphorus	(4.860±1.088)	(4.378±0.905)	0.675
Magnesium	(2.042±0.367)	(1.869±0.377)	0.834
Sodium	(124.500±9.729)	(134.340±7.058)	0.069
Potassium	(2.688±0.916)	(3.702±0.643)	0.007

**Significance of p.value ≤ 0.05*

Table 3. Comparison of renal parameters according to FAB classification (L1) among study population before and after treatment

Parameters	L1		p. value
	(Mean ± SD)		
	Before	After	
Urea	20.896±25.666	20.195±32.915	0.273
Creatinine	2.434±0.970	2.604±1.372	0.296
Uric Acid	2.873±0.988	3.809±2.345	0.345
Calcium	5.072±3.141	4.962±3.030	0.247
Phosphorus	5.276±1.172	3.397±1.215	0.256
Magnesium	2.388±0.772	2.302±0.835	0.393
Sodium	123.17±10.038	54.381±64.883	0.209
Potassium	2.627±0.883	3.770±0.698	0.237

**Significance of p.value ≤ 0.05*

Table 4. Comparison of renal parameters according to FAB classification (L2) among study population before and after treatment

Parameters	L2		p. value
	(Mean ± SD)		
	Before	After	
Urea	18.846±25.660	25.008±34.19	0.248
Creatinine	2.106±1.089	2.252±1.22	0.386
Uric Acid	2.757±0.953	3.935±2.248	0.234
Calcium	5.276±3.121	5.495±3.230	0.267
Phosphorus	3.463±1.243	3.854±1.322	0.378
Magnesium	2.393±0.756	2.921±0.875	0.390
Sodium	55.269±60.884	53.269±61.34	0.345
Potassium	2.614±0.857	2.845±0.925	0.234

**Significance of p.value ≤ 0.05*

Table 5. Comparison of renal parameters according to FAB classification (L3) among study population before and after treatment

Parameters	L3 (Mean ± SD)		p. value
	Before	After	
Urea	66.8±46.11	48.3±36.94	0.224
Creatinine	1.56±0.886	2.32±1.24	0.324
Uric Acid	3.45±1.21	6.18±2.75	0.237
Calcium	8.78±0.97	8.17±0.90	0.376
Phosphorus	5.73±1.05	3.90±1.16	0.073
Magnesium	2.13±0.40	2.02±0.57	0.083
Sodium	119.8±11.2	137.5±4.68	0.715
Potassium	2.62±0.85	3.88±.519	0.291

**Significance of p.value ≤ 0.05*

Table 6. Comparison of renal parameters among study population before and after treatment according

Parameters	Male		Female		p. value
	Mean ± SD	No	Mean ± SD	No	
Urea	53.85±30.92	24	47.461±27.598	26	0.563
Creatinine	1.490±0.941	24	1.900±0.973	26	0.716
Ureic Acid	3.140±1.351	24	3.134±1.020	26	0.262
Calcium	8.340±0.755	24	8.124±0.679	26	0.676
Phosphorous	4.700±1.257	24	5.038±0.915	26	0.297
Magnesium	1.987±0.409	24	2.069±318	26	0.978
Sodium	125.347±8.386	24	123.615±11.031	26	0.055
Potassium	2.656±1.021	24	2.699±0.852	26	0.421

**Significance of p.value ≤ 0.05*

4. DISCUSSION

The present study was carried out to estimate the serum levels of urea, creatinine, uric acid, sodium, potassium, calcium, phosphorous, and magnesium among patients with Acute Lymphoblastic Leukemia's in Radiation and Isotopes Center of Khartoum (RICK), during the period from February 2020 to January 2021; 50 samples were included, the participants involved including both males and females, the males were 24 with 48% while the rests 26 were females with 52% from different area in Sudan (east is 2%, west is 64%, north is 10%, south is 12%, and center is 12%), have different classification of Acute Lymphoblastic Leukemia's (L1 is 17 with 34%, L2 is 27 with 54% and L3 is 6 with 12%).

The present study showed statistically insignificant difference between the mean of the serum levels of urea, creatinine, uric acid, sodium, calcium, phosphorous, and magnesium in the study groups before and after treatment (P-value $>$ 0.05), and showed statistically significant difference between the mean of the serum level of potassium in study groups before and after treatment (P-value$<$0.05), the serum levels of potassium is low in the study group before treatment when compared with study group after treatment. That illustrated in Table 1. The result of potassium, phosphorous and magnesium is agree with study conducted by (Alea F. Salman, 2013) [12], and disagree in the result of sodium and calcium, and the results of urea and creatinine are disagree with the study conducted by (Aisha Alhejazy Abdalla, 2018) [13] which concluded is increased.

The results of this study showed statistically insignificant difference between the serum levels of urea, creatinine, uric acid, sodium, calcium, phosphorous, potassium and magnesium in the study groups before and after treatment

according to gender and FAB classification (P-value＞0.05). That illustrated in Tables 2, 3, 4 and 5.

The treatment of leukemia (imatinib) may cause hypocalcaemia and hypophosphatemia [14]. “Hyponatremia has been estimated to occur in approximately 10% of patients with acute hematologic malignancies” [15], “patients with acute leukemia was significantly lower in potassium when compared with healthy controls” [16], “hypermagnesuria occurs in approximately 15% in acute leukemia patients” [17], “hypophosphatemia may be multifactorial in patients with a hematologic malignancy” [18], “in leukemia, hypercalcemia can occur in the acute and chronic phases” [19].

5. CONCLUSION

This study concluded that the serum level of potassium is increased after the treatment, and the treatment of ALL not affect the serum levels of urea, creatinine, uric acid, sodium, calcium, phosphorous, and magnesium.

The gender of patients not affect the serum levels of urea, creatinine, uric acid, sodium, calcium, phosphorous, potassium and magnesium before and after treatment, also the FAB classification of ALL have no effect of the serum levels of urea, creatinine, uric acid, sodium, calcium, phosphorous, potassium and magnesium before and after treatment.

6. RECOMMENDATIONS

The serum level of potassium should be estimated during the treatment. Further studies should be carried out with larger sample size and including the patient diet.

CONSENT AND ETHICAL APPROVAL

Ethical approval was obtained from ethical committee of Al Yarmouk College and Informed consent was taken from administrative.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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