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Research Article

Association between kidney dysfunction and electrolytes imbalance among HIV patients attending Muhororo District Hospital

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Abstract

Background: Kidney diseases has been recognized as one of the challenging complications in HIV infected people. Hyponatremia and hyperkalemia are the most disturbed electrolytes associated with an increased risk of death both in hospitalized and in ambulatory HIV patients.

Aim: The study aimed to assess the association between renal dysfunction and serum electrolytes disorders among HIV infected patients.

Method: It was a retrospective study conducted at Muhororo district hospital from May up to July 2023. HIV infected patients were enrolled in the study and their serum creatinine, sodium, potassium and chloride were tested and the results analyzed by using SPSS version 22. A P-value less than 0.05 was considered statistically significance.

Result: Among 115 HIV infected patients, 67.8% were females and 32.1% were males. The Mean serum creatinine was elevated among HIV infected patients [1.01(mg/dl**)** ±0.27, 0.99(mg/dl) ±0.26], and 40.8% had hyponatremia, 8% had hypernatremia, 6% had hypokalemia 7.8% had hyperkalemia 17.3% had hypochloremia and 20% had hyperchloremia Mean serum sodium was slightly decreased [134.1**(**mmol/l**)** ±11.8], there was no change in mean of both serum K^+ and CL^- [4.4 (mmol/l) SD±1 / 100.7(mmol/l) with SD±14.2 for serum Cl-]. Serum creatinine was significantly associated with Na^+ and K^+ [P=0.04, r=-0.19/ p=0.01, r= 0.22] however the correlation between Cl- and Serum creatinine was not statistically significant [P=0.3, r=-0.08].

Conclusion: The study found elevated serum creatinine and, the weak correlation between creatinine and electrolytes in HIV infected patients on ART. The present findings need to be confirmed with further studies with large sample size. HIV infected patients should change life style that predispose their health to the development of kidney diseases they must also stick on healthcare provider's counselling.

Keywords: HIV, Kidney Dysfunction, Serum electrolytes.

INTRODUCTION

HIV infection life expectancy is improving with antiretroviral therapy, but chronic kidney disease remains a major health concern among HIV-infected individuals. This condition is a common complication, influenced by HIV, ART type, and traditional risk factors[1]. Globally, CKD prevalence varies between 8% and 16%, with a higher prevalence in Northwest Mexico. HIV patients on antiretroviral therapy achieve viral replication suppression and immunological reconstitution, but may suffer from premature aging and chronic inflammation, leading to non-communicable diseases like diabetes and hypertension[1].

Hyponatremia, a serum sodium concentration below 135 mmol/l, is a common electrolyte abnormality in clinical practice, with a prevalence of 4% to 7% in ambulatory settings and 15% to 30% in hospital care. It is associated with increased mortality risk in HIV patients[2]. HIV infection and AIDS cases were first identified in 1986 in India, leading to progressive immune system failure, allowing life-threatening infections and certain cancers to thrive[3].

HIV-infected individuals experience a variety of renal diseases, including acute kidney injury, electrolyte and acid-base disturbances, HIV-associated glomerular disease, acute-on chronic renal disease, and adverse side effects. The prevalence of these diseases in sub-Saharan Africa varies, suggesting a broader range of histopathological lesions[4].

HIV is a global public health issue, with 35.3 million people living with it in 2012, including 25 million in sub-Saharan Africa. It is the third leading cause of kidney failure among Black Americans aged 20-64. The Kigali HIV Incidence Study found

HIV prevalence in female sex workers and clients. Chronic kidney disease is a significant health concern among HIV-infected individuals, with 24% prevalence in female sex workers and 13% in HIV counseling clients in Kigali. Severe renal disease increases mortality risk fivefold in HIV patients[5].

Patients with HIV infections are at risk of acute and chronic kidney diseases due to antiretroviral drugs and the balance of electrolytes and fluid can be altered leading to an imbalance of certain electrolytes and patients are at an increased risk of death[6]. This study was conducted to assess the kidney function and explore the association with electrolytes imbalance that can increase the risk of death in HIV patients under ART. The study would have a positive impact on the health of HIV infected patients if monitoring was continuously and periodically done in association with other kidney profile parameters.

METHODOLOGY OF THE STUDY

Study area

The study was carried out at Muhororo district Hospital in Outpatient department, ARV, Internal medicine and laboratory departments located in Western province, Ngororero district in Gatumba sector.

Study design

This was a retrospective study. This study used quantitative methods in data collection and also used secondary data which had been recorded in the computer system of the Hospital. Data recorded from January 2022 to May 2023 were collected in period of 3 months from May to July 2023 and checked for competence, entered in Microsoft excel spread sheet and Collected information were analyzed using SPSS version 22. Descriptive statistics and Pearson's coefficient correlation test were used to provide tables and graphs for data presentation.

Data collection and processing

Records of serum creatinine Na^+, K^+, and Cl^- results were collected from EMRS and logbook of biochemistry laboratory. Information of HIV infected patients who their serum creatinine and electrolytes had been tested was obtained from ARV service data collected was from January 2022 to May 2023 Data were recorded in Excel sheet for further analysis. The values of serum Na, K, and Cl which were at the level considered as normal range were (135-145 mmol/L/3.5-5.1 mm0l/l/ 98-107 mmol/L) respectively while (0.5-0.9mg/dl) in female and (0.6-1mg/dl) in male was considered as the normal levels of serum creatinine.

Study population and Sample size

All HIV patients who attended Muhororo district hospital whom their kidney and electrolytes tests had been requested and performed in laboratory during the period from January 2022 to May 2023. The sample size of the study was selected from study population where 115 HIV infected patients who were transferred to Outpatient department to who the serum creatinine and electrolytes test had been requested and performed from January 2022 up to May 2023.

Data analysis

Data were entered into Microsoft excel spreadsheets and were analyzed and processed using Statistical package for social science version 22 (SPSS) which was used for data analysis by finding frequency, mean, standard deviation through descriptive statistics and Pearson's coefficient correlation test had been used to determine level of relationship between dependent and independent variables and establishment of tables and graphs which summarizing and represents data outcomes. The comparison was done at 95% confidence level $P<0.05$ was considered as statistically significant.

RESULTS AND DISCUSSION

Presentation of demographic characteristics of the study population

The study population related to age and gender were analysed as summarized in table 1.

Table 1: Distribution of PLHIV by age group and gender

Age group	Gender		Total n (%)
	Females	Males	
[≤15]	4	7	11(9.5)
[16-45]	27	14	41(35.6)
[46-75]	42	15	57(49.5)
>75	5	1	6(5.2)
total	**78**	**37**	115(100)

Table 1 showed that out of 115 HIV infected patients who attended OPD service Muhororo district hospital females were 78 and males were 37, with ratio of 2:1. The study participants were classified into 4 age groups, a majority of study participants were in [16-45]35.6% and [46-75]49.5% age groups because these age groups were sexually active and other live with HIV infection for long period of time. The study found that females were more infected with HIV infection than men.

In general women are more affected compared to male because women were more vulnerable than men to infection because of anatomy of their genital which is susceptible to infection in case sexual intercourse thus exposing them to sexual transmitted diseases and HIV among them, women under age 17 years are at even greater risk because they have an underdeveloped cervix and low vaginal mucus production[7].

Determination of serum creatinine levels among HIV infected people

The frequencies of normal and abnormal serum creatinine levels, the minimum, maximum, mean and standard deviation in males and females in study population were determined by descriptive statistical analysis as summarized in table 2.

Table 2*:* Distribution of creatinine levels among PLHIV(n=115)

Gender	Frequency of normal level (%)	Frequency of abnormal level (%)	Minimum level (mg/dl	Maximum level (mg/dl)	Mean (mg/dl)	Std. deviation
Female	22(19.1)	15(13)	0.27	2.17	0.99	±0.26
Male	28(24.3)	50(43.4)	0.59	2.16	1.05	±0.29
Total	48(43.4)	65(56.5)				

Table 2 showed the distribution of serum creatinine level among HIV infected patients, the normal range in male and female was [0.6-1.1 mg/dl, 0.5-0.9mg/dl]. The study found that in all 115 study participants 56.5 % in both genders had abnormal high serum creatinine whereas 43.4% had normal creatinine level, male and female had a mean of [1.05(mg/dl), ±0.29/0.99(mg/dl), ±0.27] respectively, the mean values obtained from the study in both male and female were similar with the upper limits of serum creatinine normal ranges which was considered as high serum creatinine in HIV infected patients but not for normal people. An increase of serum creatinine was an indicator of developing kidney diseases in HIV infected people on ART, thus leading health care provider to directly change ARV regimen.

The study findings were in line with the study conducted by Verma & Singh in 2019, who have observed that among 510 HIV/AIDS patients hospitalize in a tertiary care center of India, reported that Acute renal failure was seen in 15% and CKD was found in 13% of HIV patients furthermore with elevated serum creatinine[8,13]. The reason why creatinine elevated among HIV infected patients would be due to the effect of anti- retroviral therapy treatments because some of them have nephrotoxicity which harm the renal parenchyma cells and lead to alteration of organ in removal of waste product from the body.

Determination of serum sodium, potassium and chloride levels among HIV infected people

The frequencies of normal and abnormal serum sodium, potassium and chloride levels, the minimum, maximum, mean and standard deviation in males and females in study population were determined by descriptive statistical analysis and summarized in table 3.

Table 3*:* Distribution of serum electrolytes in PLHIV (n=115)

Electrolytes	Frequency of normal level n (%)	Frequency of abnormal level n (%)		Minimum level (mmol/l)	Maximum level (mmol/l)	Mean (mmol/l)	Std. deviation
		High	Low				
Sodium	60(52.1)	8(6.9)	47(40.8)	100	170	134.1	±11.8
Potassium	99(86)	9(7.8)	7(6)	2.19	12.71	4.4	± 1
Chloride	74(63.4)	23(20)	20(17.3)	3.81	135.5	100.7	±14.2

Table3 shows that out of all 115 study participants, 40.8% had hyponatremia, 7% had hypernatremia, 6% had hypokalemia, 7.8% had hyperkalemia, 17.3% had hypochloremia and 20% had hyperchloremia, the majority of the study participants had normal levels of Na^+, K^+, and Cl^- (52.1%,86% and 63.4%) respectively. However, the mean levels of Na^+, K^+, and Cl^- in study participants were (134±11.8mmol/L, 4.4±1 mmol/L, 100.7±14.2 mmol/L) respectively. The mean Na^+ was decreased while K^+ and Cl^- were in normal ranges. The results agreed with the work of Okpa *et al*., which found lower serum sodium among 163 HIV infected patients under High Active Antiretroviral Therapy attended Emuoha General Hospital in Nigeria[9].

On the other hand, the study also found no abnormal in serum K^+ and Cl^- levels among HIV infected patients which means that many participants from the study population had serum potassium and chloride which was in normal range. These results were in similar with the work of Afhami *et al.,* 2007 who found no abnormality of serum K^+ and Cl^- levels among 65 HIV-infected patients who attended outpatient counseling center of Tehran University of Medical Sciences in Iran, the significant difference observed in K^+ conformed with the work which found that HIV-infected individuals have a significant lower abnormality in systemic K+ equilibrium was not supported by this study[9,10].

Association between serum creatinine and electrolytes

In this study the level of association between serum creatinine and electrolytes among HIV infected patient was done by correlating serum creatinine with each serum electrolyte using Pearson's coefficient correlation test. The relationship between creatinine with sodium, potassium and chloride was determined by the r- value obtained while P- value indicated if the correlation was statistically significant.

Correlation between serum creatinine and sodium

Statistical analysis to correlate creatinine and sodium electrolyte was performed by using Pearson's coefficient correlation test, $P<0.05$ was considered as statistically significant. Results were summarized in figure 1.

The study obtained correlation of creatinine with sodium was ($p=0.04$, $r= -0.19$) there was weak negative correlation which was statistically significant, means that when creatinine levels elevated there was a decrease of serum sodium ion concentration among HIV infected patient. Coefficient of determination which is noted as R^2 was 0.037 means that only 3.7% of decrease in Na^+ was influenced by increase in creatinine.

The graph shows a down ward trend, the relationship between serum creatinine and sodium was weak negative Because the data points do not lie along a line, that was as the level of serum creatinine elevated there was a decrease of serum Na^+ among HIV infected patients. This agrees with the works done by Ramesh in 2017 and Verma & Singh in 2019 which reported elevated serum creatinine and decrease of sodium in HIV infected patients[8,11].

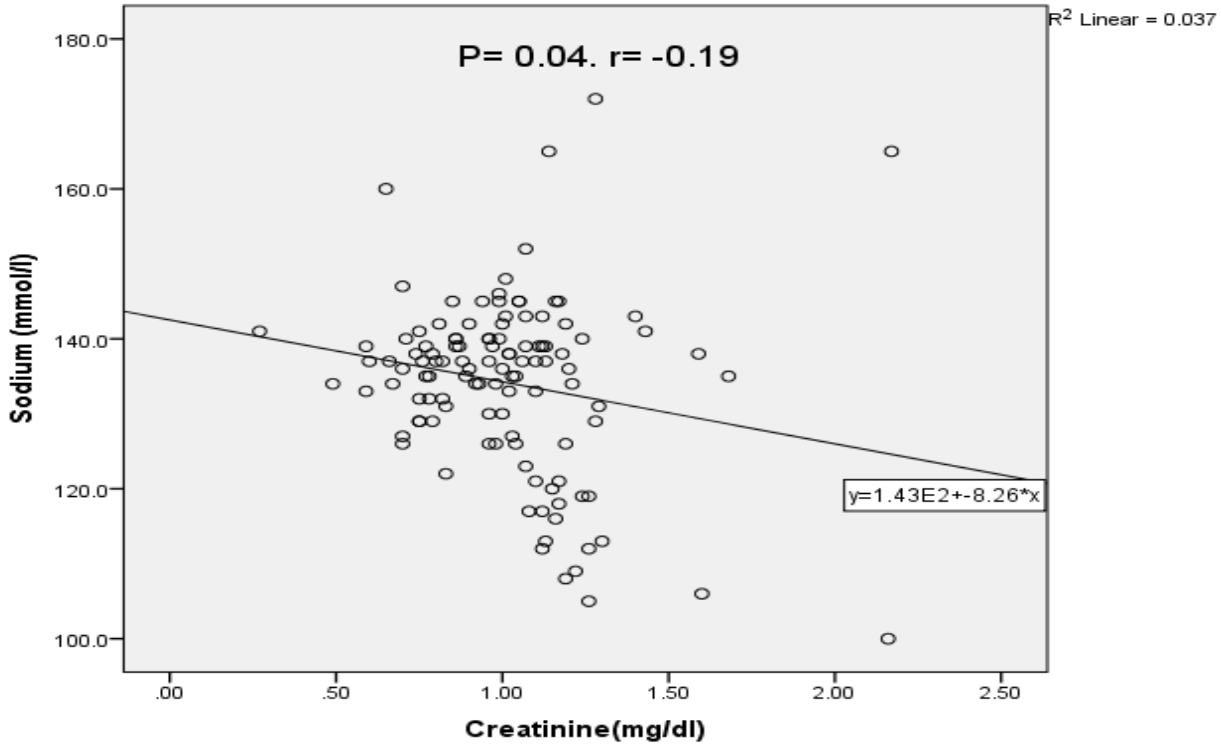

Figure 1: Correlation between serum creatinine and sodium

Correlation between serum creatinine and Potassium

Statistical analysis to correlate creatinine and potassium electrolyte was performed by using Pearson's coefficient correlation test, P<0.05 was considered as statistically significant. Results were summarized in figure.

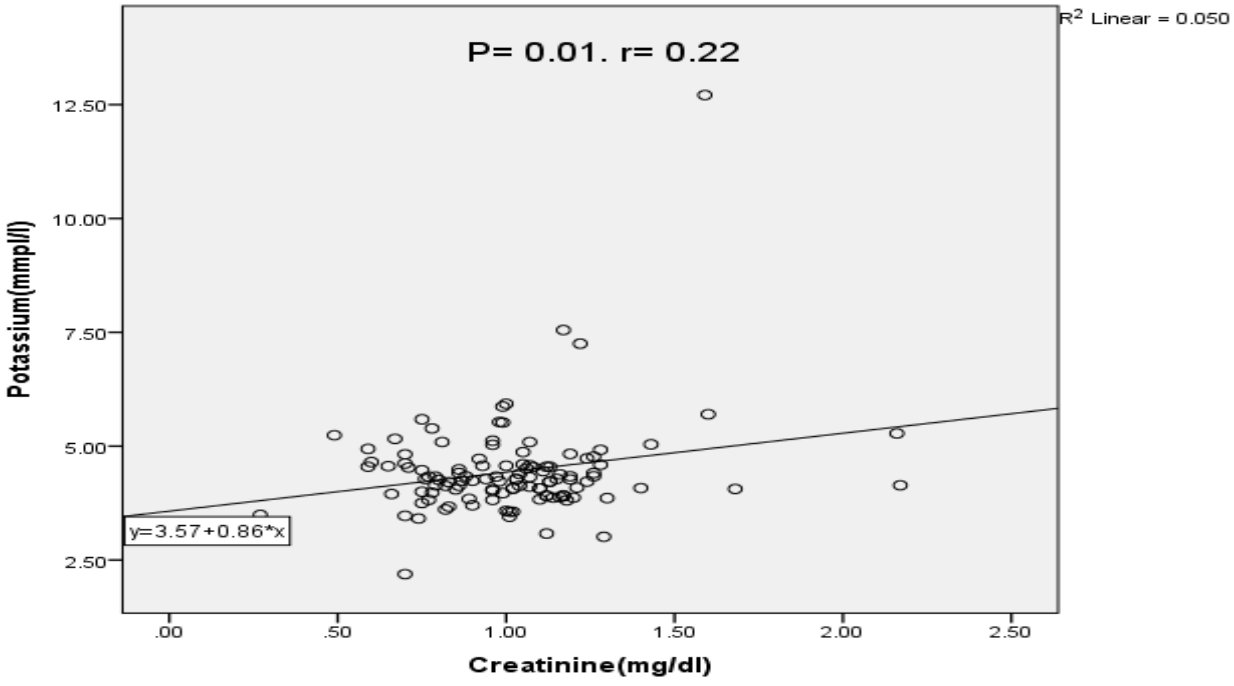

Figure 2: Correlation between serum creatinine and potassium

The study obtained statistically significant correlation between serum creatinine and potassium (P=0.01, r=0.22), with the graph showed an upward trend thus the association between serum creatinine and potassium was weak positive correlation means that as the level of serum creatinine elevated there was an increase of serum K^+ among HIV infected patients. Coefficient of determination which is noted as R^2 was 0.05 means that only 5% of increase in K^+ was influenced by increase in creatinine.

These results were in line with past study conducted by Ramesh in 2017 which reported that there was elevated serum creatinine and increase in potassium level among 200 HIV positive patients attending ART center of Govt. Rajaji Hospital in India[8]. HIV infection can damage the kidney's filters making it less able to efficiently excrete potassium; some common treatments of HIV like sulfamethoxazole-trimethoprim therapy are also associated with elevated serum potassium levels[12].

Correlation between serum creatinine and Chloride

Statistical analysis to correlate creatinine and chloride electrolyte was performed by using Pearson's coefficient correlation test, P<0.05 was considered as statistically significant. Results were summarized in figure.

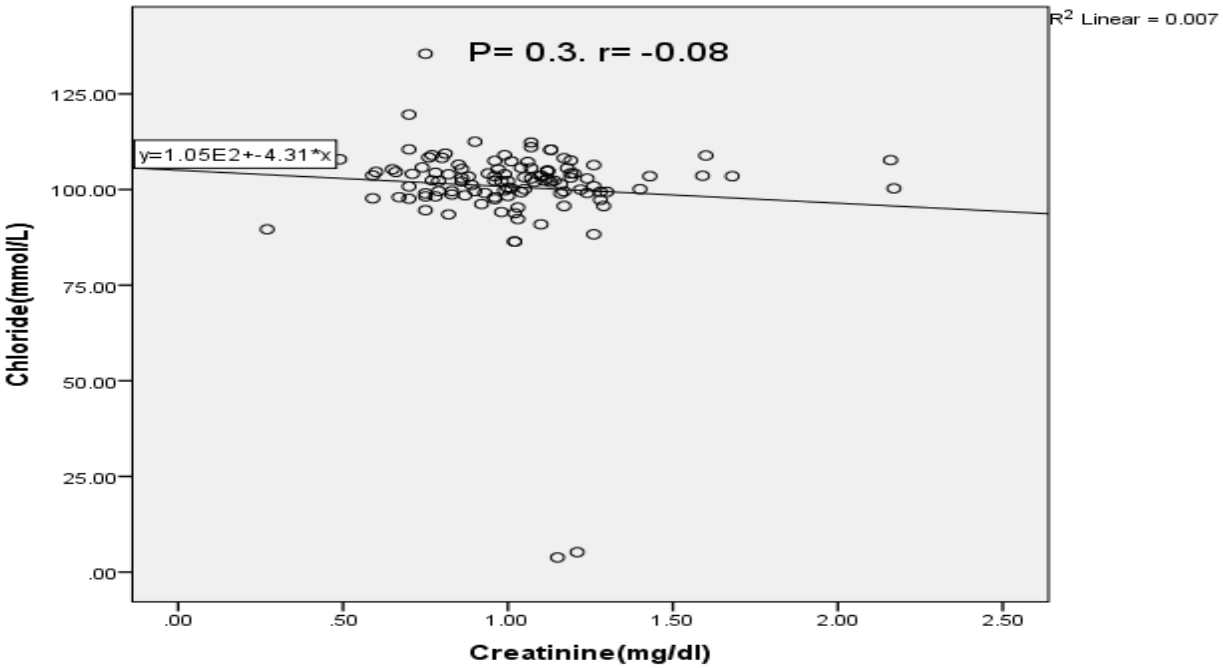

Figure 3*:* Correlation between serum creatinine and Chloride

The study obtained no statistically significant relationship between serum creatinine and chloride [P=0.3, r=-0.08], P<0.05 was considered as statistically significant, and found out absence correlation between serum creatinine and Cl-. the study found out there was no statistically significant association between serum creatinine and chlorine among HIV infected patients, R^2 was 0.007 means that only 0.7% of decrease in Cl- was influenced by increase in creatinine. The study results were in line with the work who found that among 65 HIV infected patients there was no HIV-associated nephropathy with Chloride disorder in their study[10]. The reason why there was absence of association in the current study and previous one may be due to small sample size in the study.

CONCLUSION

The majority of the study participants were in age group of forty-six and seventy-five. Moreover, the majority had elevated serum creatinine and hyponatremia, potassium and chloride results were in normal ranges, creatinine levels were statistical correlated with sodium and potassium. However, sodium was negatively correlated with creatinine, the study also found no correlation between creatinine and chloride. The study objectives were achieved.

HIV infected people should change life style that predispose their health to the development of kidney diseases. They must also stick on healthcare providers counselling and respect good ART adherence for optimizing antiretroviral success in order to minimize opportunistic infections. In addition, day by day counselling about the importance of taking ART on time and in the correct way and drinking of water in order to avoid renal failure and electrolytes disorder. Finally, I recommend to other researchers to seek for other factors associated renal diseases and electrolytes imbalance other than Anti-retroviral therapy with larger sample size.

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Author Contributions

All authors contributed equally for this study.

Conflict of interest

Authors declare no conflict of interest

Fundings

N/A

Ethical consideration

Prior to this study, official approval to conduct this study was obtained from Muhororo District Hospital by the Director of the Hospital. The principle of confidentiality and respect of patient privacy are the rule as the research was carried out in health sector and the results were only used for academic purpose. Laboratory numbers was used as unique identifiers in order to maintain confidentiality which was corresponding to the visit numbers of the Hospital Information System (HIS).

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