



## Serum protein status and electrolyte profile of HIV/AIDS patients on HAART in UPTH, Rivers state – Nigeria

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### Article Info

Volume 2, Issue 3, July 2020

Received : 19 October 2019

Accepted : 17 March 2020

Published : 09 July 2020

doi: [10.33472/AFJBS.2.3.2020.88-93](https://doi.org/10.33472/AFJBS.2.3.2020.88-93)

### Abstract

Despite successes achieved due to the wide availability and improvement of combination antiretroviral therapy regimens, there are still serious complications common in Human Immunodeficiency Virus (HIV) patients on (highly active antiretroviral therapy) HAART. This study seeks to evaluate the serum protein status and electrolyte profile of HIV/AIDS patients on HAART in University of Port Harcourt Teaching Hospital (UPTH). The electrolytes were determined by colorimetric method while total protein and albumin concentration were determined by spectrophotometric methods, but globulin and A/G ratio were determined by calculation. The result obtained indicated a significantly higher total protein ( $p < 0.05$ ) in male HIV patients on HAART when compared to the male non HIV patients. For albumin, the result indicated a significantly lower value ( $p < 0.05$ ) in female and male HIV patients on HAART ( $2.38 \pm 0.22$  and  $3.27 \pm 0.22$  g/dL respectively) when compared to the control. A/G ratio in male and female HIV patients on HAART was also significantly lower ( $0.54 \pm 0.09$  and  $0.69 \pm 0.09$  g/dL) compared to the control. From the result, a significantly lower value ( $p < 0.05$ ) in concentration of sodium of female and male HIV patients on HAART ( $132 \pm 5.20$  mMol/L and  $136.12 \pm 4.85$  mMol/L respectively) when compared to the control. The result for bicarbonate indicated a significantly lower value ( $p < 0.05$ ) in female HIV patients on HAART ( $23.24 \pm 2.20$  mMol/L). Though the levels of most of the parameters analyzed were found within the normal range, serum protein and electrolyte monitoring in patients with HIV is recommended once treatment is recommended.

**Keywords:** Serum protein, Electrolyte, HIV/AIDS, HAART

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### 1. Introduction

Human Immunodeficiency Virus (HIV) is a linear single-stranded, enveloped RNA virus of the Retroviridae family which attacks immune cells called CD4 cells, which are types of T cells thereby causing acquired immunodeficiency syndrome (Zhang et al., 2011). AIDS is a common condition which has considerable impact on the ability of the body to fight infections. The virus is widely transmitted through contact of infected people with semen, vaginal secretion, breast milk or blood by uninfected persons (Stanley and Madhavan, 1999). There is evidence that HIV plays a crucial role in damaging the immune system which helps the body to fight off infections (Haseltine and Wong-Staal, 1988).

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Since the beginning of HIV/AIDS epidemic, more than 70 million people have been infected with about 35 million death recorded (UNAIDS, 2019a) and cases of newly infected individuals occurs in a matter of minute every day. As at March 14, 2019, the HIV prevalence rate in Nigeria is 1.4% among adult aged 15 to 49 years, with about 1.9 million people living with HIV/AIDS (UNAIDS, 2019b).

Since it was reported, HIV infection has been attracting a lot of interest in its treatment and prevention presently there is no known cure for HIV/AIDS but the use of antiretroviral drugs can help prevent secondary infections and complications while slowing down the disease's progression (WHO, 2019). Antiretroviral drug is fast becoming a key instrument in the effective management of HIV. Antiretroviral therapy is the use of drugs in management of HIV infection and (Highly active antiretroviral therapy) HAART is the combination of three or four ART (NACO, 2013). Three drugs are used mainly with a view of reducing drug resistance which usually a rise from the use of ART. HAART is therefore frequently prescribed as frontline drug in reducing viral load, thereby keeping the immune system strong to fight off opportunistic infections (Abdulazeez, 2012). HIV/AIDS is increasingly recognized as a serious, worldwide public health concern but HAART has changed the course of HIV infection with improvement in quality of life (Kenneth and Kartik, 2010). Apart from the benefits, HAART have numerous side effects and its consequences are an important, but understudied, cause for concern. A spectrum of abnormalities has been described in HIV patients on HAART. In light of recent events in the use of HAART by HIV patients, it is becoming extremely difficult to ignore the existence of hepatic and renal abnormalities. Hepatotoxicity in the HIV infected patients are among the greatest cause of non-AIDS-related death in patients with HIV disease (Weber et al., 2006). Serum protein level is therefore a rough measure of major functional changes in liver functions (Agrawal and Johri, 1990). The decrease in some serum proteins could be attributed to changes in free amino acids metabolism and their synthesis in the liver (Rivarola and Balegno, 1991). This adverse effect might be caused by the interference of HAART with protein synthesis (Cawson et al., 1982).

A spectrum of renal abnormalities has also been described in HIV infected patients (Bhupendra and Amrita, 2019). These patients are frequently exposed to medications that can adversely affect renal function (George and Anushree, 2014). Having considered the continuous increase in HIV infection, renal abnormality such as HIV associated nephropathy are likely to become increasingly prominent (Winston, 2001). Major renal complications in HIV infection are a spectrum that results in potentially reversible acute renal failure primarily acute tubular necrosis and HIV associated nephropathy. Any disease or condition that causes a fall in the glomerular filtration rate (GFR) will affect plasma proteins and electrolytes. The occurrence of kidney function abnormalities was estimated to range between 10% and 20% of the adult population in most countries worldwide (Beaglehole and Yach, 2003). In Nigeria however, the occurrence of preventable renal disease has not been determined (Afolabi et al., 2009) but data available appear to suggest a high prevalence within the country. Abioye-Kuteyi et al. (1999) reported a prevalence rate of 19.9% of undetected renal diseases in a rural populace in Western Nigeria. In 2008 a 38% prevalence of renal disease was observed in Nigerian HIV/AIDS patients who were on antiretroviral drugs (Emem et al., 2008).

A number of serum proteins and electrolyte abnormalities can arise in HIV patients on HAART, yet these receive little attention in literature. This study seek to evaluate the protein status and electrolyte profile of serum as a tool for monitoring hepatic and renal changes in HIV/AIDS patients on HAART in University of Port Harcourt Teaching Hospital (UPTH).

## 2. Materials and methods

The study was carried out at UPTH, Rivers state Nigeria. A total of 50 randomly selected HIV males and females on HAART and 50 age/sex matched HIV-seronegative volunteers were enrolled into the study. Inclusion criteria for the patients were: positive testing to HIV antibody assay using an ACON HIV 1/2 Rapid Human Immunodeficiency Virus Test Strip and further confirmation of same using immunocomb HIV 1/2 Biospot (Oregenis, Israel). Patients were also included if they were aged 18-50 years, and on HAART and if their informed consent was given through completing and signing of the informed consent form. Exclusion criteria were: family history of liver and kidney disease; presence of any confounding illness like tuberculosis, HCV or any opportunistic infection as well as CD4+ cell count less than 200 cells/ $\mu$ l of blood.

### 2.1. Sample collection

A 5 ml portion of venous blood was collected from each subject by venupuncture and allowed to clot. This was later centrifuged in a Wisperfuge (Model 684) centrifuge at 2,500 g for 5 min and then analyzed for the different

parameters. Serum albumin (ALB) was determined by the method of Doumas *et al.* (1971), serum total protein (TP) by the method of Tietz (1995), serum globulin was calculated thus; serum globulin = total protein – serum albumin (TP – ALB). A/G ratio was also by calculation and bicarbonate by titration as described by Tietz (1987). Serum sodium, potassium and chloride levels were determined by ion selective electrode method using Humalyte machine (Human, Germany) (Tietz, 1987).

### 3. Statistical analysis

Results were analyzed using Statistical Package for Social Sciences (SPSS) version 10.0. The data were expressed using descriptive statistics and percentages. Values were given as mean  $\pm$  standard deviation.

Students *t*-tests were used to compare groups and Spearman's correlation coefficients used to establish associations. *P*-values less than or equal to 0.05 were taken as statistically significant.

### 4. Results

The demographic data of the studied population is as shown in Table 1. The result of the measured biochemical parameters are presented in Table 2. Serum total protein and globulin concentrations were significantly reduced in both male and female HIV patients on HAART relative to their control levels while serum albumin and A/G ratio concentrations were significantly increased in both male and female HIV patients on HAART relative to their control levels. Serum sodium and bicarbonate were significantly increased in female HIV patients on HAART compared to the control, whereas in the male patients, the increase was not significant. None of the patients was hypernatremic ( $>145$  mEq/L) while 30.8% of the patients were hyponatremic ( $<135$  mEq/L). All the patients were within the normal potassium reference level. There was no significant difference in serum potassium concentration of all the patients compared to their controls. Correlation analysis revealed a positive association between sodium and bicarbonate ion concentrations ( $r = 0.35$ ) and a negative association between potassium and bicarbonate ion concentrations ( $r = -0.37$ ) in the male HIV patients on

**Table 1: The demographic data of the studied population**

Parameters	Test	Control
Sample size	50	50
Age range (years)	18-50	18-50
Male	25	25
Female	25	25

**Table 2: The result of the measured biochemical parameters**

Serum parameter	Male		Female	
	Test	Control	Test	Control
Total protein (g/dL)	8.06 $\pm$ 0.32*	7.41 $\pm$ 0.24	6.81 $\pm$ 0.38*	6.67 $\pm$ 0.17
Albumin (g/dL)	3.27 $\pm$ 0.22*	5.12 $\pm$ 0.38	2.38 $\pm$ 0.22*	4.29 $\pm$ 0.32
Globulin (g/dL)	4.79 $\pm$ 0.39*	2.28 $\pm$ 0.46	4.43 $\pm$ 0.41*	2.38 $\pm$ 0.31
A/G ratio	0.69 $\pm$ 0.09*	2.36 $\pm$ 0.64	0.54 $\pm$ 0.09*	1.84 $\pm$ 0.36
Sodium ion (mmol/L)	136.12 $\pm$ 4.85	139.20 $\pm$ 4.55	132.00 $\pm$ 5.20*	138.36 $\pm$ 2.89
Potassium ion (mmol/L)	4.13 $\pm$ 0.37	4.27 $\pm$ 0.52	3.98 $\pm$ 0.49	4.12 $\pm$ 0.31
Bicarbonate ion (mmol/L)	24.80 $\pm$ 1.89	26.84 $\pm$ 2.84	23.2 $\pm$ 2.20*	26.68 $\pm$ 1.60

**Note:** \* Significant difference at  $p \leq 0.05$ .

HAART. No such association was found in the females. However, total protein and globulin concentrations were found to be positively associated in both male ( $r = 0.63$ ) and female ( $r = 0.68$ ) HIV patients on HAART.

## 5. Discussion

A wide range of renal and hepatic abnormalities has been described in HIV infected patients (Bhupendra and Amrita, 2019; and Weber et al., 2006) and it is among the greatest causes of non-AIDS-related death in patients with HIV disease. HIV patients on HAART are frequently exposed to medications that can adversely affect renal and hepatic function (George and Anushree, 2014). This present study exhibits quite some abnormalities in serum protein status and electrolyte profile of HIV patients on HAART. There was a significantly higher value ( $p < 0.05$ ) in concentration of total protein of female and male HIV patients ( $6.81 \pm 0.38$  g/dL and  $8.06 \pm 0.32$  g/dL). The value obtain is slightly above the normal range for total protein which is 6.0 – 8.0 g/dL.

The high serum total protein could be as a result of hyperglobunemia. Although serum total protein has limited clinical important when compare to albumin due to compensatory increase in other proteins during HIV infection. The relevance of serum total protein in evaluation of renal and kidney diseases cannot be ignored (Johnson et al., 2012). The decrease in serum total protein observed in this present study can be associated with increase lost /catabolism in HIV infection or it may be the side effect of HAART as observed by Okuonghae et al. (2013).

For albumin, the results obtained indicated a significantly lower value ( $p < 0.05$ ) in concentration of female and male HIV patients ( $2.38 \pm 0.22$  and  $3.27 \pm 0.22$  g/dL respectively) the decrease can be related to the effect of HAART on CD4 count. Guenter (1993) reported that serum albumin level is related to CD4 count. The decrease in albumin could be attributed to changes in free amino acids metabolism and their synthesis in the liver (Rivarola and Balegno, 1991). This adverse effect might be caused by the interference of the drug with protein synthesis (Cawson et al., 1982). In an attempt to clarify the mechanism involved, Hoffman et al. (1985) reported that toxicants in some drugs caused a disruption in protein and RNA synthesis.

Although the serum albumin level was decreased due to HAART, serum globulin level was however increased hence affecting the total protein level.

AIDS is usually associated with reduce serum albumin occasion by hyper catabolism, malabsorbtion and protein lost.

For globulin, the results obtained indicated a significantly higher value ( $p < 0.05$ ) in concentration of female and male HIV patients ( $4.43 \pm 0.41$  and  $4.79 \pm 0.39$  g/dL respectively). The increased in globulin concentration may indicate an immunodepressive response (Savory and Hammond, 1980). Liver is the site of albumin synthesis but globulin is formed by the lymphatic system to some extent (Jones and Bark, 1979). Increased serum concentrations of globulin as observed in this study lend credence to the submission that the liver function may be impaired. The concentration of A/G ratio in male and female HIV patients were also significantly lower ( $0.54 \pm 0.09$  and  $0.69 \pm 0.09$  g/dL respectively).

Both globulin and albumin are also produced by the liver. If the liver is damaged, it can no longer produce these proteins. The results presented on serum proteins are consistent and all pointing to the fact that the liver may have been damaged by HAART.

The mean lower level of sodium  $\text{Na}^+$  found in HIV patients on HAART is consistent with another study. (Frampton, 2013) were the decrease was attributed to the loss of  $\text{Na}^+$  through diarrhoea due to the effect of the drugs.

The mean  $\text{K}^+$  level of HIV patients on HAART was significantly higher. This can be attributed to the facts that in HIV/AIDS infection, there is the destruction of cells by the drug, high grade pyrexia/fever (causing the destruction of cells) and therefore leading to the influx of  $\text{K}^+$  from the cells to the plasma (Macleod, 2001).

The significantly lower bicarbonate level of HIV patients on HAART can be attributed to the body's compensatory mechanism to maintain electrochemical neutrality due to the plasma levels of  $\text{Na}^+$  and chloride (Abramowitz et al., 2009).

## 6. Conclusion

The changes in serum total protein, albumin, and globulin and A/G ratio of HIV patients on HAART can be attributed to the effect of therapeutic regime. We therefore advocate a routine measurement of this parameters

in HIV patients on HAART to have a better understanding of such patients in order to decrease morbidity and mortality.

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**Cite this article as:** Igwe, K. O., Ujowundu, C. O., Chieme, S. C. and Obasi, U. K. (2020). Serum protein status and electrolyte profile of HIV/AIDS patients on HAART in UPTH, Rivers state – Nigeria. *African Journal of Biological Sciences.* 2(3), 88-93.