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Total Bilirubin, Albumin, Electrolytes and Anion Gap in HIV Positive Patients in Nigeria

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In this study total bilirubin, albumin and electrolytes levels in HIV positive persons were determined followed by anion gap calculation. This is with a view to generating the non-existent baseline data that could aid in monitoring the progression of AIDS in resource limited settings like ours. Results of the various analysis showed that the concentrations of the conjugated, mean total and unconjugated bilirubin in HIV positive persons ranged from 0.50 to 1.3, 1.07 to 2.10 and 0.01 to 1.50 mg/100 mL, respectively while those for the control subjects, (HIV non-infected) were from 0.50 to 1.66, 0.80 to 1.60 and 0.10 to 0.70 mg/100 mL, respectively. Also while the mean total and unconjugated bilirubin concentrations were higher in HIV positive persons than in the non-infected, the reverse was found to be the case for albumin levels. The albumin levels of HIV positive persons ranged from 29 to 37 g L^{-1} and for the uninfected it was from 34 to 39 g L^{-1}. The results of the electrolyte determination revealed that the mean concentrations of the electrolytes in HIV positive persons were 99.3 mmol L^{-1} (Cl^-), 18.08 mmol L^{-1} (HCO_3^-), 132.4. mmol L^{-1} (Na^+) and 3.3 mmol L^{-1} for K^+. For the uninfected the mean values recorded included 100 mmol L^{-1} (Cl^-), 20.3 mmol L^{-1} (HCO_3^-), 137.4 mmol L^{-1} (Na^+) and 4.08 mmol L^{-1} (K^+). The results of the electrolytes determination are all within normal range though there were slight decreases in the HIV (+) persons. The anion gap values overlapped between the infected and the non-infected.

Key words: Bilirubin, albumin, electrolytes, anion gap, HIV, AIDS, HIV-positive

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INTRODUCTION

The human immunodeficiency virus (HIV), the virus that causes the acquired immune deficiency syndrome (AIDS) was identified in 1983. As at the end of 2003, about 70 million people had been infected and more than 42 million still living with the virus while 15,000 people worldwide are infected each day[1-3]. Sub-Saharan Africa is worst hit as more than 70% of the over 42 million persons infected worldwide live here and AIDS is now the leading cause of death in the region. Nigeria the most populous country in Africa has over 4 million persons living with HIV/AIDS and a national sero prevalence of 5.8% as at the end of 2001[4-6].

Several factors have been identified as fueling the epidemic in Africa. Such factors include ignorance of the disease, lack of access to prevention, low socio-economic status of women, inadequate treatment and care services and stigma and discrimination[5,7-10]. Despite all the progress in HIV and AIDS science since 1981, the epidemic unfortunately continues to progress in the developing world, where over 95% of people infected with HIV live[11]. Though researchers have been making steady progress in the past 11 years, the pace according to Peter Piot the Executive Director of UNAIDS, is not fast enough for all the people who could benefit from it[9,12]. The antiretroviral drugs used in treatment are very expensive and unavailable and cannot reach millions of infected people who need them. As a result, for the uninfected, prevention is still better, but for the infected accurate and timely diagnosis and treatment are needed to prolong life span and improve quality of life as well as reduce the frequency and duration of hospital admission[13].

In countries where resources are plentiful, monitoring of HIV infection includes routine chemical assessment and measurement of $CD4^+$ T lymphocyte counts and plasma HIV load. These indicators are used to determine disease stage and progression, assist in decisions regarding when to start or change ART and assess treatment response. On the other hand, for resource-limited settings Kent *et al.*[14] asserted that biological and social reasons such as HIV clades, differences in prevalence of co-infections and socio-economic differences make it inappropriate to apply the guidelines developed in wealthy industrialized countries in Sub-Saharan Africa and other poor nations.

From the foregoing, it is imperative that researches are required for the development of simple and rapid diagnostic tests upon which to build the guidelines for treatment that at the moment are exceedingly limited with standard monitoring tests largely inaccessible to many[3].

The present study seeks to measure some biochemical parameters of both HIV/AIDS patients and non HIV patients in Nigeria with a view to generating preliminary data that could be used in identifying the infection early and in monitoring the progression of the disease.

MATERIALS AND METHODS

Ethical approval: Permission was obtained from the Ethical Clearance Committee of the Jos University Teaching Hospital (Ref. JUTH/DCS/ADM/127/VOL-XVI/217).

Sample preparation: Blood samples were taken by venepuncture from 80 HIV positive patients attending Jos University Teaching Hospital and from 80 persons that are HIV negative. Serum was prepared by centrifugation using MSE minor centrifuge model at 1,500 rpm for 5 min. The serum samples were stored at –20°C until needed for analysis.

Determination of bilirubin levels: Bilirubin was determined by the Vanderbergh method[15] based on the diazo reaction. The conjugated, unconjugated and total bilirubin levels were measured in all the samples.

Assay of albumin: The bromo cresol green (BCG) method was employed in the determination of the concentrations of albumin in the serum samples[15].

Analysis of electrolyte concentrations: Chloride concentration was determined using the mercuric nitrate method while bicarbonate was assayed by back titration. Potassium and sodium were analyzed with the flame photometer[15].

Calculation of anion gap: Anion gap was calculated using the following equation:

$$\text{Anion gap} = Na^+ - (HCO_3^- + Cl^-)$$

RESULTS AND DISCUSSION

The conjugated, mean total and the unconjugated bilirubin levels of HIV patients ranged from 0.50-1.30, 1.07-2.10 and 0.01-1.50 mg/100 mL, respectively. For the non-infected control subjects, values of 0.50-1.66, 0.80-1.60 and 0.10-0.70 mg/100 mL, respectively were obtained for the conjugated, mean total and unconjugated bilirubin levels. The mean total and unconjugated bilirubin concentrations were higher in HIV-infected persons (Table 1). This agrees with Tietz[15] who observed

Table 1: Bilirubin levels in HIV positive and HIV negative persons

Bilirubin levels in HIV positive patients				Bilirubin levels in HIV negative persons		
Sample No.	C1	C2	C2-C1	C1a	C2a	C2a-C1a
1	0.60	1.30	0.70	0.53	1.07	0.50
2	0.90	1.60	0.70	0.80	1.07	0.70
3	0.80	1.30	0.50	0.90	1.30	0.24
4	1.06	1.30	0.24	0.90	1.07	0.24
5	1.20	1.30	0.10	0.60	0.80	0.10
6	0.90	1.60	0.70	0.60	1.30	0.47
7	1.20	1.87	0.67	1.06	1.07	0.70
8	1.30	2.10	0.80	0.90	1.07	0.20
9	0.90	1.30	0.40	0.50	0.82	0.40
10	0.90	1.30	0.40	0.60	1.07	0.54
11	0.60	1.60	1.00	0.60	1.07	0.30
12	1.20	1.60	0.40	0.50	0.80	0.17
13	1.30	1.87	0.57	0.60	1.07	0.47
14	0.80	1.30	0.50	0.90	1.30	0.47
15	1.06	1.30	0.70	1.66	1.60	0.30
16	0.90	1.30	0.40	0.90	1.30	0.70
17	1.20	1.60	0.40	0.60	1.07	0.17
18	0.60	2.10	1.50	0.50	1.07	0.10
19	0.80	1.87	1.07	0.60	0.80	0.30
20	1.30	1.87	0.57	1.06	1.07	0.47
21	1.30	1.87	0.57	1.06	1.07	0.24
22	0.53	1.87	1.34	0.50	1.30	0.50
23	0.53	1.60	1.17	0.90	1.07	0.70
24	1.30	1.87	0.57	0.60	0.80	0.10
25	0.60	1.30	0.70	0.80	1.07	0.70
26	1.06	1.07	1.01	0.60	1.30	0.47
27	1.30	2.10	0.80	0.50	1.07	0.20
28	1.06	1.07	0.01	0.60	0.80	0.40
29	0.80	1.07	0.27	1.66	1.07	0.70
30	0.80	1.30	0.50	0.60	1.60	0.17
31	0.60	1.60	1.00	0.90	1.60	0.54
32	1.30	1.60	0.30	0.90	1.30	0.47
33	1.30	1.60	0.30	0.60	1.07	0.30
34	1.30	1.87	0.57	0.53	1.30	0.30
35	0.60	1.30	0.70	1.06	1.07	0.47
36	1.06	1.30	0.04	0.90	1.07	0.17
37	0.60	1.60	1.00	0.50	0.80	0.10
38	0.80	1.07	0.57	0.60	1.07	0.30
39	0.50	1.30	0.80	0.60	1.07	0.47
40	1.20	1.60	0.40	0.90	0.80	0.24
41	1.30	1.60	0.30	0.90	0.80	0.10
42	0.90	1.30	0.40	0.60	1.07	0.70
43	0.80	1.30	0.50	0.60	0.82	0.17
44	0.60	1.30	0.07	0.50	1.07	0.20
45	1.30	1.60	1.10	0.90	0.80	0.50
46	0.80	1.60	0.80	0.60	1.07	0.47
47	0.50	1.30	0.80	0.53	1.07	0.54
48	0.60	1.60	1.00	0.60	1.60	0.70
49	0.80	1.87	1.07	0.60	1.07	0.24
50	0.60	1.07	0.47	1.06	1.07	0.40
51	0.80	1.60	0.80	0.90	1.30	0.70
52	0.90	1.60	0.70	0.80	1.07	0.47
53	0.50	1.30	0.80	0.90	1.30	0.47
54	0.90	1.07	0.17	1.06	1.07	0.30
55	0.80	1.60	0.08	0.60	0.80	0.30
56	0.60	1.30	0.70	0.50	1.07	0.10
57	0.60	1.07	0.47	0.60	1.30	0.17
58	0.90	1.60	0.70	0.90	1.07	0.30
59	0.60	1.30	0.70	0.50	1.30	0.30
60	0.80	1.07	0.27	0.66	1.07	0.24
61	0.80	1.30	0.50	0.90	1.30	0.24
62	0.50	1.30	0.80	0.60	1.07	0.70
63	0.80	1.30	0.50	1.06	1.07	0.40
64	0.60	1.30	0.70	1.06	0.80	0.47
65	0.60	1.07	0.47	0.90	0.80	0.47

Table 1: Continue

Bilirubin levels in HIV positive patients				Bilirubin levels in HIV negative persons		
Sample No.	C1	C2	C2-C1	C1a	C2a	C2a-C1a
66	0.90	1.87	0.97	1.06	1.07	0.30
67	1.06	1.87	0.81	0.90	0.82	0.70
68	0.60	1.60	0.70	0.50	1.30	0.10
69	0.60	1.60	1.07	0.60	1.07	0.40
70	0.50	1.30	0.80	0.90	1.07	0.54
71	1.00	1.30	0.10	1.06	1.07	0.70
72	1.20	1.60	0.80	0.60	1.60	0.17
73	0.60	1.30	0.70	0.90	1.07	0.20
74	0.90	1.30	0.50	0.50	1.07	0.17
75	0.50	1.30	0.80	0.60	1.30	0.30
76	0.80	1.07	0.47	1.66	0.80	0.10
77	0.90	1.87	0.50	1.06	1.07	0.30
78	1.20	1.07	0.27	0.90	1.30	0.47
79	0.50	1.87	0.97	0.50	1.07	0.17
80	0.50	1.60	0.40	0.60	1.07	0.30
Sum	68.72	118.18	49.67	61.79	87.67	29.65
Mean	0.859	1.47725	0.620875	0.772375	1.095875	0.370625

Table 2: Albumin concentrations in HIV positive and HIV negative persons

HIV positive patients		HIV negative persons
Sample No.	Alb. Conc. (g L^{-1})	Alb. Conc. (g L^{-1})
1	30	38
2	30	36
3	32	35
4	35	39
5	34	36
6	36	35
7	30	34
8	32	38
9	33	35
10	30	38
11	31	38
12	32	35
13	30	39
14	30	34
15	35	39
16	36	38
17	36	38
18	32	39
19	33	38
20	34	37
21	30	36
22	30	39
23	33	36
24	34	34
25	35	35
26	33	34
27	32	39
28	33	38
29	35	37
30	35	35
31	34	34
32	30	38
33	33	35
34	30	38
35	30	35
36	37	34
37	32	37
38	33	38
39	34	39
40	32	34
41	31	36
42	32	37
43	35	39
44	36	35

Table 2: Continue

HIV positive patients		HIV negative persons
Sample No.	Alb. Conc. (g L^{-1})	Alb. Conc. (g L^{-1})
46	33	38
47	32	36
48	31	38
49	33	39
50	32	34
51	34	35
52	36	34
53	35	38
54	34	35
55	35	38
56	30	36
57	30	39
58	31	34
59	32	38
60	32	37
61	31	38
62	32	39
63	33	34
64	32	39
65	32	38
66	34	35
67	32	36
68	35	38
69	32	36
70	31	34
71	32	38
72	31	35
73	34	39
74	31	38
75	30	38
76	32	34
77	35	39
78	36	35
79	29	38
80	33	38
Sum	2611	2937
Mean	32.6375	36.7125

that increase in unconjugated bilirubin may be from increase in formation of bilirubin, or as a result of a defect in its conjugation by the liver or by defective excretion. In addition, liver disease can contribute to this as well.

Table 3: Electrolytes concentrations in HIV positive and HIV negative persons

HIV positive patients					HIV negative persons			
Sample No.	Cl-	HCO_3^-	Na+	K+	Cl-	HCO_3^-	Na+	K+
1	100	18	135	3.4	110	18	135	4.0
2	102	20	130	3.0	109	17	138	4.5
3	102	18	131	3.5	107	20	135	3.8
4	104	19	136	3.6	114	22	140	3.4
5	102	18	133	3.2	106	25	141	5.0
6	103	18	130	3.0	96	20	138	4.8
7	100	18	131	3.2	95	22	137	4.6
8	103	16	132	3.9	95	19	140	3.8
9	102	17	130	4.0	100	20	142	3.6
10	104	16	134	3.9	102	23	143	3.0
11	99	16	130	3.4	95	20	132	3.5
12	101	17	130	3.2	95	21	135	3.8
13	102	18	132	3.9	98	20	134	4.1
14	96	16	130	3.0	96	20	135	4.2
15	95	20	131	3.1	96	18	135	3.8
16	100	19	133	3.2	101	20	136	5.1
17	104	24	135	3.3	98	20	132	3.2
18	105	21	132	3.2	96	19	140	3.8
19	102	20	135	3.0	95	22	142	4.5
20	96	19	137	3.2	101	21	136	3.8
21	95	19	134	3.2	109	20	140	5.0
22	98	17	130	3.3	109	20	142	5.0
23	104	17	132	3.2	114	18	132	4.8
24	102	18	133	3.4	96	20	141	3.4
25	103	16	138	3.1	96	20	135	3.6
26	100	20	132	3.2	100	23	140	3.5
27	100	18	136	3.1	100	19	142	5.1
28	100	16	131	3.0	106	18	135	4.6
29	101	18	133	3.2	101	22	138	3.0
30	98	18	134	3.0	114	21	135	3.8
31	98	17	133	2.9	102	20	135	4.5
32	100	21	132	3.0	92	20	137	3.8
33	96	16	136	3.4	95	17	143	4.2
34	95	18	135	3.5	98	18	135	4.1
35	93	15	133	3.6	96	20	132	3.8
36	102	18	133	3.2	101	19	136	3.6
37	91	17	136	3.1	98	20	142	4.0
38	103	17	130	3.0	101	19	140	3.8
39	95	16	131	3.2	96	20	134	4.1
40	92	17	134	3.4	95	18	138	4.2
41	104	18	137	3.1	95	20	138	3.4
42	103	16	132	3.1	98	25	135	3.8
43	102	16	131	3.1	96	18	141	5.0
44	92	19	133	3.2	92	20	138	4.5
45	91	17	135	3.0	95	22	132	4.8
46	87	20	131	3.0	101	23	134	4.0
47	90	19	130	3.4	101	20	135	4.6
48	100	18	131	3.0	114	18	143	3.6
49	103	17	131	3.1	101	20	137	3.5
50	104	20	136	3.2	96	19	135	4.1
51	106	18	130	3.3	95	17	141	4.6
52	100	19	131	3.8	109	20	140	3.0
53	101	20	133	3.6	106	25	135	4.2
54	100	21	134	3.8	95	22	132	5.1
55	98	19	131	3.0	101	19	140	3.8
56	92	16	131	3.2	102	20	142	5.0
57	90	16	130	3.5	95	23	135	3.4
58	102	18	130	3.4	96	19	132	4.5
59	103	18	131	3.9	106	22	135	3.8
60	96	16	135	3.5	100	22	132	4.2
61	105	20	130	2.9	95	20	136	4.5
62	108	17	131	3.0	92	20	142	3.8
63	89	18	133	3.2	96	23	150	5.1
64	88	19	130	3.3	95	20	135	4.6
65	92	17	140	3.9	101	22	138	3.8

Table 3: Continue

	HIV positive patients				HIV negative persons			
Sample No.	Cl-	HCO_3^-	Na+	K+	Cl-	HCO_3^-	Na+	K+
66	105	21	130	4.2	101	20	132	4.5
67	109	19	141	4.5	95	21	136	4.0
68	108	16	131	4.6	101	17	135	5.0
69	103	18	130	3.0	96	20	135	3.2
70	106	17	132	3.3	102	21	137	4.8
71	103	16	130	3.0	95	20	134	3.8
72	100	21	131	3.2	96	22	140	3.0
73	92	19	130	3.4	109	21	135	3.8
74	106	20	130	3.2	95	22	140	3.2
75	103	19	131	3.0	98	21	136	4.6
76	101	16	130	3.3	107	20	143	3.5
77	102	17	130	4.5	107	19	142	4.5
78	109	18	131	3.4	95	20	140	4.5
79	82	19	130	3.0	96	21	138	3.8
80	79	20	133	3.4	101	19	138	3.6
Sum	7942	1445	10590	266.7	7991	1622	10992	326.7
Mean	99.275	18.0625	132.375	3.33375	99.8875	20.275	137.4	4.08375

Table 4: Average values of anion gap between HIV infected and Non-infected

	HIV Infected							Non-infected		
1	18	21	21	41	15	61	7	07	22 04	16
2	10	22	17	42	13	62	3	12	18.15	10
3	14	23	12	43	13	63	31	08	20 22	14
4	14	24	15	44	14	64	23	04	15 12	25
5	16	25	19	45	25	65	32	10	25 16	22
6	11	26	14	46	20	66	12	22	07 14	04
7	15	27	18	47	23	67	12	20	22 18	12
8	14	28	16	48	14	68	11	26	16 08	18
9	10	29	12	49	11	69	9	22	08 20	19
10	16	30	19	50	13	70	10	18	12 25	21
11	18	31	19	51	7	71	13	17	21 07	22
12	12	32	11	52	13	72	12	22	26 19	15
13	12	33	20	53	15	73	24	16	10 21	14
14	21	34	22	54	11	74	3	19	22 17	20
15	19	35	16	55	17	75	12	21	04 25	25
16	16	36	15	56	24	76	14	15	14 26	07
17	11	37	24	57	27	77	14	14	08 22	25
18	7	38	13	58	8	78	2	25	19 10	17
19	12	39	23	59	14	79	28	25	22 25	22
20	23	40	26	60	24	80	38	14	17 22	26

Bilirubin on its own is not transported into the body because it is insoluble in water. In order to be transported into the body, bilirubin becomes attached to serum albumin.

The trend is the reverse in the case of total albumin. The mean total albumin (36.7 g L^{-1}) is higher in the non-HIV infected subjects than in the infected (36.4 g L^{-1}) (Table 2). Since serum protein gets depleted by HIV infection, there will be lower levels of albumin available for transport of bilirubin. Consequently, there will be a high amount of accumulated bilirubin that is untransported. Albumin also gets suppressed as a result of the suppressive effect of HIV and as a result of increased catabolism from cell damage.

The results revealed higher levels of Na^+, K^+, Cl-and HCO_3^- and these were more in the non-infected subjects than in HIV-positive subjects (Table 3). This is not unexpected since the HIV infected subjects were not down with AIDS yet. However the lower values for the infected suggest some degree of dehydration. Furthermore, the average values for anion gap were very high for both the infected and the uninfected (Table 4). Essentially the values were above the normal range of 10-12 mg L^{-1}. The anion gap is used mainly in diagnosing different causes of metabolic acidosis some disease conditions like diabetes mellitus, lactic acidosis, chronic renal failure. Methanol or ethylene glycol poisoning also lead to increased anion gap. According to Tietz[15], the production or ingestion of organic acid toxins or renal failure cause increased anion gap.

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