Original Article

Antioxidants in HIV Positive Children

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ABSTRACT

Objective. To assess the antioxidant status in HIV positive children.

Methods. HIV positive children under the age group of 3-12 years from lower socio- economic strata were chosen for the study (Group 1). The values were compared with normal children (Group 2) not suffering from any disease in the same age group and similar socio-economic strata. The antioxidants chosen for the present study were vitamin A (Retinol), vitamin C (Ascorbic acid) and vitamin E (α tocopherol).

Results. Results obtained were subjected to statistical analysis using student 't' test (in the present study 'z' test was applied). The antioxidants vitamin A, C and E decreased in HIV positive children as compared to controls. Vitamin A was significant to the level of $p< 0.01$ and vitamin C and E to the level of $p< 0.001$ and $p< 0.02$ respectively.

Conclusion. The decrease in antioxidants A, C and E in HIV positive children is due to increased utilization of antioxidant micronutrients because of increased oxidative stress caused due to free radicals. **[Indian J Pediatr 2008; 75 (4) : 347-350]**
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Key words : *Antioxidants; HIV; Oxidative stress*

Human Immunodeficiency Virus (HIV), the etiological agent of Acquired Immunodeficiency Syndrome (AIDS) is a highly mutable virus belonging to the lentivirus subgroup of the family Retroviridae. This bloodborne and sexually transmitted disease evolved from Simian Immunodeficiency Virus (SIV) that affects monkeys. AIDS is a condition whereby the body's specific defence system against all infectious agents no longer functions properly[1].

Literature documents that people with HIV/AIDS are in a state of oxidative stress, because of excess production of free radicals. Results from laboratory experiments (Sean Hosein treatment update, 1997, Vol 77, No 7)[2] suggest that chronic oxidative stress can affect the immune systems fight against HIV, possibly by: increasing the production of HIV, weakening the immune system, making T cells destroy themselves, causing cells to make abnormal chemicals and making the body more sensitive to toxic effect of certain drugs.

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Carole and Craig and many other researchers[3] agree that in the early stages of infection, a deleterious reduction–oxidation (redox) imbalance may occur. This means that increased damage causing reactive oxygen intermediates called "free radicals" are generated which may cause damage to cell membranes, proteins and nucleic acids resulting in stores of naturally occuring antioxidant reducing agents being depleted. Of the mechanisms contributing to this, progressive oxidative stress and increased lipid peroxidation induced by the production of reactive oxygen species (ROS) play a critical role in the stimulation of HIV replication and the of immunodeficiency. Such damage may be prevented or moderated by a normal antioxidant defence system that scavanges the ROS.[4]

The purpose of the present study was to measure the concentrations of these various antioxidant scavengers *viz.* vitamin A, C, and E in the serum of HIV positive children and compare the values with age matched controls.

The role of vitamin A in HIV-I infection has been of great interest during the past ten years. Early observational studies found strong associations between low serum retinol concentration and HIV-I disease progression and infectivity.[5] Several studies[5-14]suggested a decreasing trend in vitamin A (retinol) levels in HIV positive children.

Lower levels of vitamin E may play a pathogenic role in the onset and development of AIDS and other infections.[15] Several studies revealed lower vitamin E levels in HIV positive children.[4,6,7,12,13,15]

Ascorbic acid supressess human immunodeficiency virus (HIV) replication.[16] A decreasing trend in vitamin C was noted by many researchers [4,12,13,16] in HIV positive children.

MATERIALS AND METHODS

A total of 165 children were studied for a duration of 2 years and categorized as follows:

Group 1 : 80 HIV positive children (46 males and 34 females) in the age group of 3-12 years residing in the slum areas located at Dharavi and of lower socio economic strata of the society attending routine outpatient department (OPD Pediatrics) of Lokmanya Tilak Municipal Medical Hospital situated amidst Mumbai's biggest slum known as Dharavi.

Group 2 : 85 children in the age group 3-12 years (53 males and 32 females) were studied as controls. The control group comprised of children not suffering from any disease of the same age group and of similar socio-economic strata residing in Dharavi.

10 ml of venous blood was drawn by venepuncture in different containers. For the estimation of vitamin C, blood was collected in heparin vacutainer and for vitamin A and E, blood was collected in plain vacutainer. The following tests were done:

1. Vitamin A by a spectro-photometric method (Paterson and Wiggins method) using ultraviolet spectrophotometer.[17]
2. Vitamin C was estimated by Harris and Ray method.[18]
3. Vitamin E by Baker and Frank method.[19]

RESULTS

The antioxidants vitamin A, C and E were monitored in 80 HIV positive children (males 46 and females 34) in the age group of 3-12 years (mean ± S.D age 7.5 ± 2.8) and 85 control children (males 53 and females 32) of the same age group (mean S.D of age 8.7 ± 2.5). The results were subjected to statistical analysis. Unpaired 't' (in the present study 'z' test) was applied and the statistical significance was established.

The mean ± S.D of vitamin A in HIV positive children was 0.3 ± 0.1 mg/L and that of the control group was 0.4 ± 0.24 mg/L. The values obtained from our study showed decrease in the level of vitamin A in HIV positive children as compared to control group. The statistical significance $p < 0.01$ showed that the decrease was moderately significant. Table 1 and Fig 1.

Vitamin C in HIV positive children exhibited a marked statistically ($p<0.001$) significant decrease in their level as compared to controls (0.79 ± 0.36 mg/dl to 0.58 ± 0.36 mg/dl). Table 1 and Fig 2. A considerable decrease in vitamin E level was observed in HIV positive children (mean ± S.D is 9.03 ± 2.80 mg/L) than in control group (mean ± S.D is 10.08 ± 2.69 mg/L). The statistical analysis $p<0.02$ showed a moderate significance. Table 1 and Fig 3.

These results indicate that HIV positive children are deficient in vitamin A, C, and E. Table 1 depicts the mean ± S.D values of vitamin A, C and E.

Among the antioxidants A, C and E, it was observed that there is more depletion of vitamin C as compared to A and E. This indicates that HIV positive children are more deficient in vitamin C than in vitamin A and E.

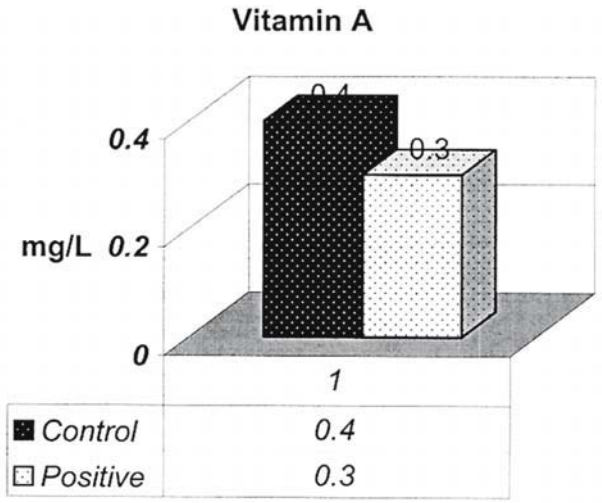

Fig. 1. Vitamin A levels in Control and HIV positive patients

Table 1. Antioxidant Levels in HIV Positive and Control Children

Parameter	HIV-positive children	Control children	'P' Value	Significance
	n_1=80	n_2 =85		
Vit-C (mg/dl)	0.58 ± 0.36	0.79 ± 0.36	< 0.001	Highly significant
Vit-A (mg/L)	0.30 ± 0.17	0.40 ± 0.24	< 0.01	significant
Vit-E (mg/L)	9.03 ± 2.80	10.08 ± 2.69	< 0.02	significant

Values Expressed as Mean ± Standard deviation

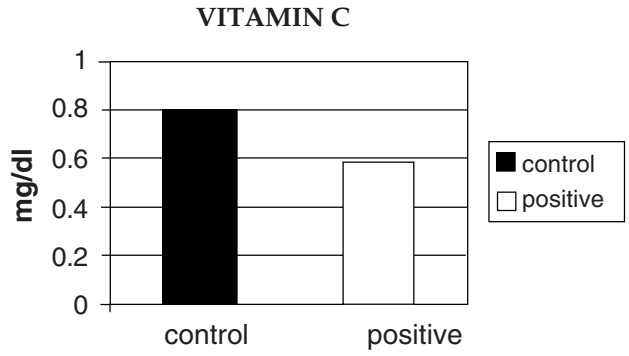

Fig. 2. Vitamin C levels in Control and HIV positive patients

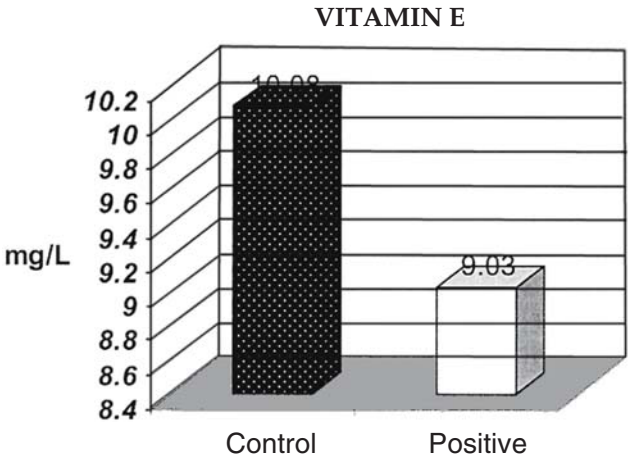

Fig. 3. Vitamin E Levels in HIV positive and control children

DISCUSSION

The present study showed decreased levels of vitamin A in HIV positive children. The fall in vitamin A level was from mean and standard deviation of control (0.41±0.24 mg/L) to mean and standard deviation of HIV positive children (0.30±0.17 mg/L). The results were in general agreement with those of previous studies by Jared M Baeten, Richardson *et al*[5-13] in which lower vitamin A levels were noted in HIV positive children than in noninfected normal controls.

Serum retinol declines during acute phase response because of reduced synthesis of retinol binding protein. Retinol is transported in a 1 to 1 complex with retinol binding protein (RBP). Since RBP and retinol exist in circulation in equimolar concentration, RBP could be used as a measure to predict marginal vitamin A status, as determined by serum retinol. RBP was a sensitive and specific marker for serum retinol concentration.[5]

A close relationship between infectious disease and vitamin A status have long been known from both epidermilogical studies of human beings and studies of experimental infections in animals.[14] Vitamin A deficiency seems to be associated with altered immunity, due to abnormalities in T cell subsets and selective loss of CD4 cells from lymph nodes, thymus and spleen. Body stores of vitamin A may be depleted during serious infection because of decreased dietary intake, malabsorption, increased metabolism and urinary losses. Retinol is excreted in urine of AIDS patients.[14] Therefore, there is deficiency of retinol in AIDS patients. This explains the decreased concentration of vitamin A in HIV positive children in the present study as compared to controls.

In the present study, we observed significantly lower levels of ascorbic acid in HIV positive children than in normal controls. These results were in accordance with studies carried out by many researchers Johane P Allard, Jenny Chau *et al*[4,12,13,16].

The deficiency of vitamin C in HIV positive population is probably due to increased utilization of vitamin C which is on account of increased oxidative stress. Oxidative stress causes formation of peroxyl radicals. Although ascorbic acid cannot scavenge lipophilic radicals within the lipid compartment by itself, it acts as a synergist with tocopherol.[20] This reduced ascorbic acid level in HIV positive children could be deleterious to the child as particular neurons may be vulnerable to damage resulting in the development of dementia.[16]

Results of the present study in vitamin E on HIV positive children showed signifantly lower levels as compared to non-infected controls. This is in accordance with several studies by Periquet B A, Tammes N M, Lambert *et al* which documented significantly low levels of vitamin E in HIV positive children than in controls.[4,6,7,12,13,15] In HIV positive children, due to oxidative stress free radicals are produced. Vitamin E a major lipid soluble antioxidant protects against lipid peroxidation by of scavenging these free OH^- radicals, thus explaining the fall in vitamin E levels. Furthermore in HIV positive children, prolonged deficiency vitamin E could impair fat absorption because tocopherol is found dissolved in the fat of the diet and is liberated and absorbed during fat digestion.

REFERENCES

1. John W, Sleasman M.D, Maureen M.Goodenow. HIV-1 infection. *J Allergy Clin Immunology* 2003; 111: S583- S591.
2. Sean Hosein. HIV and Antioxidants. *Treatment Update* 1997; 7:7
3. Carole L, Craig S. Antioxidants, Oxidative stress and Nac. Gaymens Health Crisis. *Treatment Issues* 1993/94; 7: 11.
4. Johane P, Allard, Elaheh, Jenny Chau *et al.* Oxidative stress and plasma antioxidant micronutrients in humans with HIV infection. *Am J Clin Nutr* 1998; 67 : 143-147.
5. Jared MB, Barbra AR, Daniel DB. Use of serum retinol-binding protein for prediction of Vitamin A deficiency. *Am J Clin Nutrition* 2004; 79 : 218-225.
6. Periquet BA, Jammes NM, Lambert WE *et al.* Micronutrient

levels in HIV-1- Infected Children. *J AIDS* 1995; 9: 887-893.
7. Ziari SA, Mireles VL, Cantu CG *et al.* Serum vitamin A, vitamin E, and beta-carotene levels in preeclamptic women in northern nigeria. *Am J Perinatol* 1996; 13: 287-291.
8. Nazrul Islam SK, Jahingir Hossain K, Absan M. Serum vitamin E, C and A status of the drug addicts undergoing detoxification: influence of drug habit, sexual practice and lifestyle factors. *Eur J Clin Nutrition* 2001; 55: 1022-1027.
9. Melikian G, Mmiro F, Ndugwa C *et al.* Relation of vitamin A and carotenoid status to growth failure and mortality among Ugandan infants with human immunodeficiency virus. *Nutrition* 2001; 17: 567-572.
10. Henrik F, Exnevia G, Pernille K *et al.* HIV and other predictors of serum β-carotene and retinol in pregnancy: a cross-sectional study in Zimbabwe. *Am J Clin Nutr* 2001; 73: 1058-1065.
11. William LC, Susan A, Jose OA *et al.* Serum Retinol and HIV-1 RNA Viral Load in Rapid and Slow Progressors. *J Acquired Immunodefi Syndr Hum Retrovirol* 1998; 18: 401-406.
12. Tang Alice M, Lancillotti J, Hendricks *et al.* Micronutrients: Current Issues for HIV Care Providers. *AIDS* 2005; 19: 847-861.
13. HIV/AIDS Bureau-Women's HIV/AIDS Care Guide 2005; Chapter 17.
14. Richard DS, Muhilal BJ, Ward DF *et al* Abnormal T-cell subset proportions in vitamin A-deficient children. *The Lancet* 1993; 341: 5-8.
15. Passi S, Morrone A, Picardo M, De Luca C *et al.* Blood levels of vitamin E, polyunsaturated fatty acids of phospholipids, lipoperoxides, glutathione peroxidase activity and serological screening for syphilis and HIV in immigrants from developing countries. *G Ital Dermatol Venerol* 1990; 125: 487-491.
16. Everall IP, Hudson L, Keruin RW. Decreased absolute levels of ascorbic acid and unaltered vasoactive intestinal polypeptide receptor binding in the frontal cortex in acquired immunodeficiency syndrome. *Neurosci Lett* 1997; 14 : 119-122.
17. Paterson, Wiggins, Karmarkar, Rajgopal, Bessy *et al*. Determination of Retinol by a Spectrophotometric Method Using the ultraviolet spectrophotometric. In Toro G, Philip GA, eds. *Practical Clinical Biochemistry*, 5th ed. Boston USA; Copyright by Little Brown and Co. 1980; 219-220.
18. Toro G, Philip GA. *Practical Clinical Biochemistry*, 1st ed. Boston USA; copyright by Little Brown and Co, 1975; 634-636
19. Baker, Frank. Determination of Serum Tocopherol. In Toro G, Philip GA, eds. *Practical Clinical Biochemistry,* 5th ed. Boston USA; Copyright by Little Brown and Co. 1980; 902-903.
20. Niki E. Action of Ascorbic acid as a scavenger of active and stable oxygen radicals. *Am J Clin Nutrition* 1991; 54 : 1119-1124.