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Biochemical Changes in HIV Related Malnutrition in Children

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Abstract:
Background: *Acquired Immune Deficiency Syndrome (AIDS) has become the most devastating disease humankind has ever faced. An estimated 2.5 million children around the world are living with HIV/AIDs. As HIV has many major complications in children, but main and important is malnutrition as children living with HIV/AIDS face increased challenges in maintaining proper nutrition and also are anemic.*
Aim: *The aim of this study was to investigate serum Iron and TIBC changes and total proteins and cholesterol in HIV malnourished children.*
Materials and Methods*: 100 HIV/AIDS children cases were compared with age and sex matched 50 normal control groups for estimation of serum Iron, TIBC along with Total protein, Cholesterol,and data obtained was statistically analyzed .*
Results: *Serum Iron was observed to be statistically decreased($p<0.0001$)and TIBC is statistically increased,and serum proteins and cholesterol also decreased significantly*
Conclusion: *Evaluation of Serum Iron and TIBC ,cholesterol and serum proteins in hiv children revealing of intestinal malabsorption and also increased susceptibility of infection.*
Key words: *AIDS, TIBC, malnutrition, malabsorption*

I. Introduction

Acquired Immune Deficiency Syndrome (AIDS) has become the most devastating disease humankind has ever faced. An estimated 2.5 million children around the world are living with HIV/AIDs, according to the Joint United Nations Program on HIV/AIDS (JNAIDS) "2010 Report on the Global AIDS Epidemic."

Human immunodeficiency virus (**HIV**) is a lentivirus (a member of the retrovirus family) that causes acquired immunodeficiency syndrome (AIDS),[1][2] a condition in humans in which progressive failure of the immune system allows life-threatening opportunistic infections and cancers to thrive. HIV infection leads to low levels of $CD4^+$ T cells through three main mechanisms:

First, direct viral killing of infected cells; second, increased rates of apoptosis in infected cells; and third, killing of infected $CD4^+$ T cells by CD8 cytotoxic lymphocytes that recognize infected cells. When $CD4^+$ T cell numbers decline below a critical level, cell-mediated immunity is lost, and the body becomes progressively more susceptible to opportunistic infections.

The World Health Organization (WHO) defines malnutrition as the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensuregrowth, maintenance, and specific functions.Malnutrition is a medical condition caused by an improper or insufficient diet.[3] Malnutrition is technically a category of diseases that includes: under nutrition, obesity and overweight, and micronutrient deficiency among others.[4] However it is frequently used to mean just under nutrition from either inadequate calories or inadequate specific dietary components for whatever reason.[3] The term "severe malnutrition" is often used to refer specifically to protein-energy malnutrition.[5] Protein-energy malnutrition (PEM) is often associated with micronutrient deficiency.[5] Two forms of protein-energy malnutrition are kwashiorkor and marasmus, and they commonly coexist.[3]Kwashiorkor ('displaced child') is mainly caused by inadequate protein intake resulting in a low concentration of amino acids.[3] The main symptoms are edema, wasting, liver enlargement, hypoalbuminaemia, steatosis, and possibly depigmentation of skin and hair.[3] Kwashiorkor is identified by swelling of the extremities and belly, which is deceiving of actual nutritional status.[6]

Marasmus ('to waste away') is caused by an inadequate intake of both protein and energy. The main symptoms are severe wasting, leaving little or no edema, minimal subcutaneous fat, severe muscle wasting, and non-normal serum albumin.

People living with **HIV**/**AIDS** face increased challenges in maintaining proper nutrition. Despite developments in medical treatment, nutrition remains a key component in managing this condition.

As well, the nutritional needs of people with HIV/AIDS are greater due to their immune system fighting off opportunistic infections that do not normally cause disease in people with healthy immune systems. Medication along with proper nutrition is a major component of maintaining good health and quality of life for people living with HIV/AIDS.

Relationship between Nutrition and HIV/AIDS

- HIV infection impairs nutrient intake and absorption while increasing nutrient needs;
- The risks of opportunistic infections are increased with poor nutrition thus accelerating progression of HIV into AIDS;
- The development of opportunistic infections reduce food intake leading to malnutrition in HIV;
- HIV/AIDS and malnutrition create a vicious cycle that eventually weakens the immune system.

HIV infected individuals have higher nutritional requirements than uninfected individuals, particularly with regard to protein and energy. If they suffer from opportunistic infections, they are prone to loss of appetite, even anorexia, thus reducing their dietary intake at the very time when requirements are higher. In addition, the infection sometimes interferes with the body's ability to absorb food.Several factors constitute the component of nutrition assessment. Nutrition assessment does not only mean physical measurements but also an understanding of the clinical and lifestyle behaviours of the patient. They include the following:

- Anthropometric measurements of body size or proportions (weight/, height, BMI, lean body mass, body cell mass, skin-fold thickness, body circumference)
- Biochemical assessment (albumin, Haemoglobin, CD4, CD8 counts, micronutrients, serum proteins blood sugar, lipids)
- Clinical assessment (diarrhoea, nausea, vomiting, oral sores, dysphagia, odynophagia, fever, muscle wasting, tuberculosis, anorexia, fatigue, lethargy, skin rashes)
- Diet history/food availability (food access, utilization and handling, food supplementation, appetite, eating patterns, medication,
- Lifestyle: smoking, alcohol, physical activity, caffeine
- Psychosocial factors: mood, social support systems

Biochemical Assessment

This assessment evaluates what nutrients are in a person's blood and whether the nutrients are within the normal range or not. The commonly affected nutrients include,

- **Iron**: measured as haemoglobin, which provides a total measure of the red blood cells. Depletion of iron is associated with nutritional anaemia. Iron status is usually affected by infections such as malaria and intestinal infections.
- **Serum albumin** which is the body's protector of blood volume and fluid electrolyte balance, any depletion of albumin is associated with visceral protein impairment; this test can be used as a basic screen for malnutrition. This nutrient is also affected by infection, where it will be lowered
- **Pre albumin:** it also provides sensitive measure of visceral body protein

Other biochemical tests include: total fat, cholesterol, blood sugar and vitamins such as vitamin A, C, B complex group.

II. Aims And Objectives

Malnutrition is one of the major complications of HIV infection and a significant factor in advanced disease.HIV infected individuals have higher nutritional requirements than uninfected individuals, particularly with regard to protein and energy. If they suffer from opportunistic infections, they are prone to loss of appetite, even anorexia, thus reducing their dietary intake at the very time when requirements are higher. In addition, the infection sometimes interferes with the body's ability to absorb food. Except for a low protein or low quality protein intake and chronic blood loss, patients canalso develop severe anaemia if there is a dietary deficiency of iron, Children with malnutrition have decreased blood glucose, serum proteins and total cholesterol levels.

Keeping this in view the Biochemical parameters were studied with the following objectives.

1. To study glucose, urea and creatinine concentrations in HIV malnourished children
2. To study Serum total proteins,albumin,globulins and A/G ratio in HIV malnourished children
3. To study Total cholesterol levels in HIV malnourished children
4. To study serum iron changes in HIV malnourished children
5. To study Total iron binding capacity (TIBC) in HIV malnourished children
6. To compare the above parameters in HIV related malnutrition children with that of normal healthy children.

III. Materials And Methods

The present study was conducted in the Department of Biochemistry, Rangaraya Medical College, Kakinada, Andhra Pradesh, India. Study was undertaken to determine biochemical changes in HIV related malnourished patients, in venous blood consisting of 100 patients. These values are compared with 50 normal healthy children. All of these subjects were taken from ART centre OP. After taking consent, Blood samples were obtained from Ante Cubital Vein of upper limbs of each patient. Control group were tested for HIV before conducting tests and were found negative. Plasma was separated and analysed by using standard methods. All data were expressed as mean + standard deviation. Student't' test paired two sample for means was used to compare the values. Differences with a 'p' value of less than 0.05 were considered to be statistically significant.

Biochemical analysis:

Blood samples were obtained from the subjects immediately after enrolment. Blood samples were centrifuged at 2000 × g for 10 min The samples were analyzed for Glucose, Urea, Creatinine, Total Cholesterol, Total Proteins, Albumin, A/G ratio, Iron and TIBC are God-Pod , Urease , Alkaline picrate, Cod-Pod, Biuret , Bcg Dye, Ferrozine methods respectively.

IV. Observation And Results

In the present study 100 HIV malnourished children and 50 normal healthy children below 13 years were enrolled in case and control study.

Table-1: Levels of different Biochemical parameters in venous blood of malnourished children(< 13 years) and control group**. Mean ± SD**

PARAMETER	CONTROLS (n=50)	CASES (n=100)	p value
GLUCOSE in mg/dl	100.12 ± 17.27	61.67 ±19.24	<0.0001*
UREA in mg/dl	16.32 ± 4.14	17.88 ± 5.07	NS
CREATININE in mg/dl	0.778 ± 0.243	0.822 ± 0.246	NS
TOTAL PROTEINS in g/dl	6.322 ±0.259	5.169 ± 0.863	<0.0001*
ALBUMIN in g/dl	3.196 ± 0.219	2.642 ± 0.607	<0.0001*
CHOLESTEROL in mg/dl	153.50 ± 16.38	90.18 ± 15.91	<0.0001*
IRON in µg/dl	95.12 ± 18.17	41.67 ± 12.11	<0.0001*
TIBC in µg/dl	304.22 ± 39.88	450.53 ± 103.05	<0.0001*
GLOBULINS in g/dl	3.129 ± 0.263	2.527 ± 0.70	<0.0001*
A/G ratio	0.990 ± 0.140	1.116 ± 0.533	NS

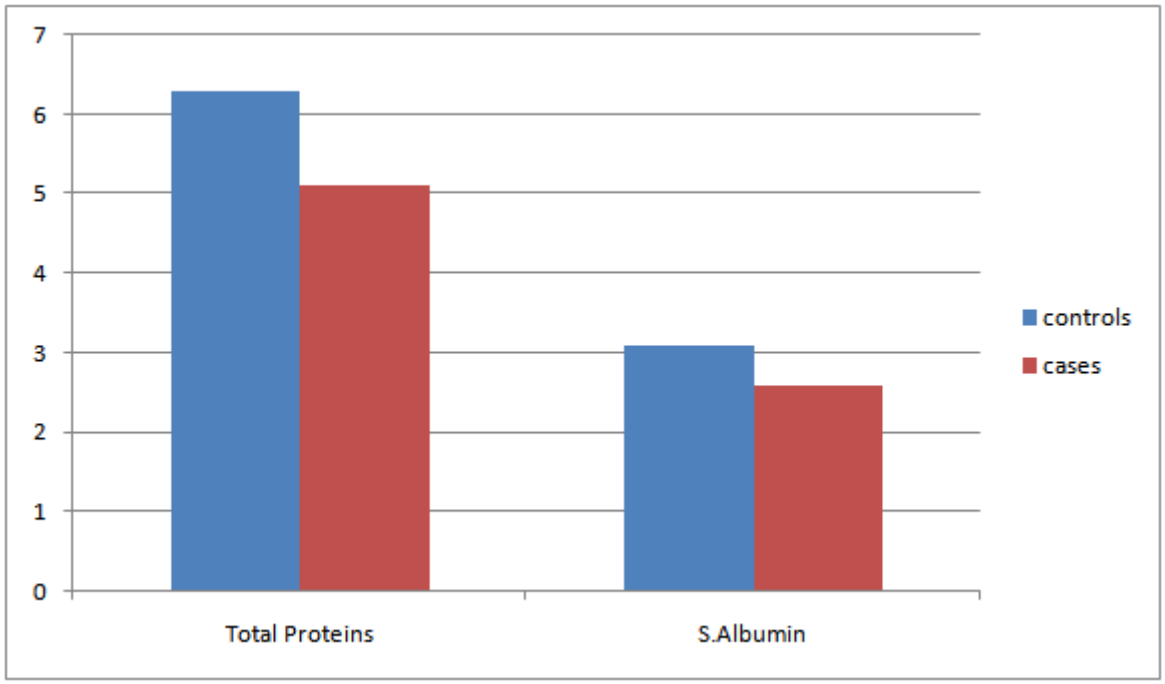

Figure 1: Bar diagram shows the values of serum toal protein and Albumin in controls and cases

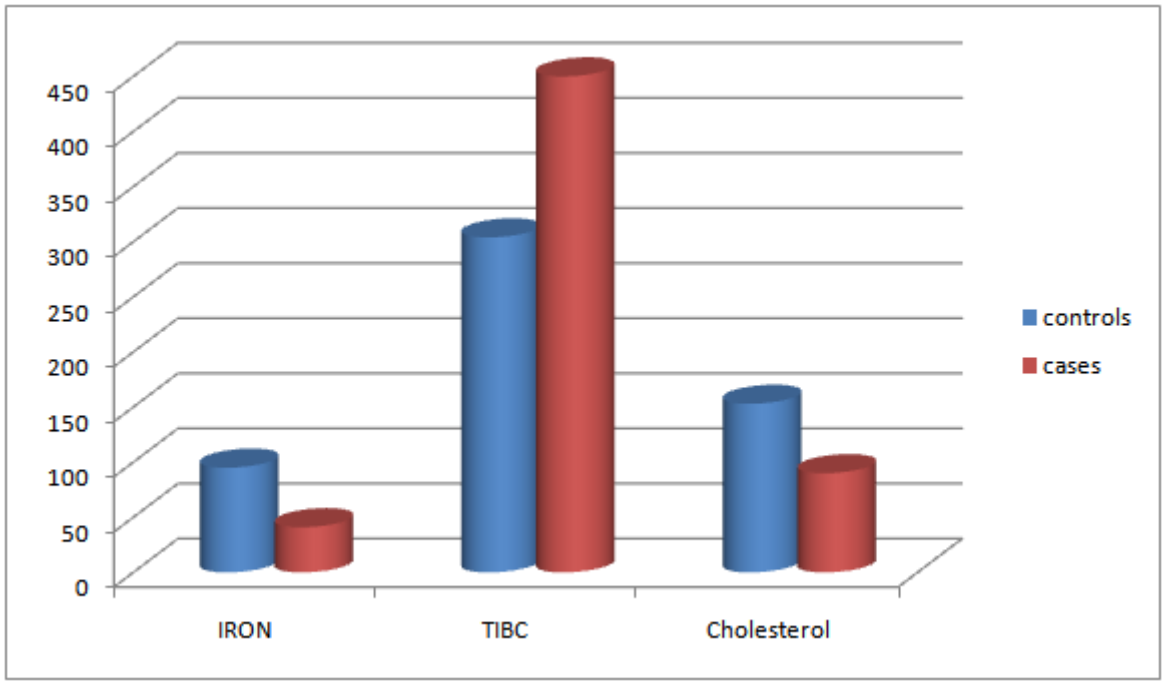

Figure 2: Bar diagram shows the values of serum Iron,TIBC, Cholesterol in controls and cases

V. Discussion

The present study deals with the basic facts on the biochemical changes in HIV malnutrition in children.

Nutrition and HIV are strongly related to each other:

Any immune impairment as a result of HIV/AIDS leads to malnutrition, and malnutrition leads to immune impairment, worsens the effect of HIV and contributes to more rapid progression to AIDS.

In the present study,the blood glucose levels are significantly decreased ($p<0.0001$)because of decreased glucose absorption, hepatic glucose production, or increased glucose clearance.A fine balance between EGP(Endogenous glucose production) and glucose clearance maintains blood glucose concentrations [9]. Decreased glucose production could be related to an impaired glucagon response, but it is not caused by increased insulin secretion Lower EGP could be caused by a decrease in glycogenolysis or gluconeogenesis.Similar result had been given by Robert H J Bandsmaetal.[9]

Total proteins,albumin are significantly decreased($p<0.0001$)decreased due to malabsorption (insufficient intake and/or digestion of proteins) . This supports the notion that hypoalbuminemia indicates a severe derangement in the child's metabolic system, reflecting a disturbance in protein metabolism, potentially cytokine-mediated inhibition of albumin synthesis or alternatively cytokine-mediated capillary leak and redistribution of albumin to the extravascular space and with increased oxidative stress. Whole-body protein synthesis and breakdown are higher in malnourished children associated with HIV. Similar study had been done by M J Manary, R L Broadheadetal[10,11]

Albumin was choosen as a marker of deterioration in the metabolic profile. The serum total protein, albumin and serum A/G ratio were significantly lower in HIV malnutrition in children than control.When comparison were done within the different grades of PEM associated with HIV, it was found that their A/G ratio were changed but not significantly.Similar results were given by Rahman MZ, Begum BA.[11]

In my present study,total cholesterol is significantly reduced ($p<0.0001$)when compared with the controls. The depression in the amount of total cholesterol was more marked in the severe forms of undernutrition.Decreases in total cholesterol have been reported in the early stages of HIV-infection,being more evident with decreasing CD4+lymphocytecountsa marker of disease progression showing a negative correlation with TNFα, TNFα receptors, and IFNγ and disturbances in cholesterol metabolismThis is important for HIV-infection pathogenesis as HDL provides cholesterol for peripheral cells involved in the immune response and tissue repair.[8]A similar result had been shown byLaura Maria D. da Silva etal.[8]

Common examples of secondary hypocholesterolemia include hyperthyroidism, various liver diseases, HIV or AIDS and malnutrition.Decreased serum levels of albumin and cholesterol significantly correlated with higher viral loads, lower CD4%, lower CD4:CD8, as well as stunting.

The important nutritional marker in HIV related malnutrition in children is Iron.

Serum iron levels are significantly decreased when compared to controls ($p<0.0001$) and it is related to intestinal malabsorption .A similar study was conducted by Castaldoetal [11]

TIBC (total iron binding capacity)is significantly increased when compared to controls($p<0.0001$). Similar observations were made by Michael H. N. Goldenetal, Ulrich E. Schaibl, Stefan H. E. Kaufmann. When infection is present and fever is observed, plasma concentrations of iron falls, causing hypoferraemia.[7]

Hypoferraemia causes changes in plasma concentrations of iron-binding proteins.

The iron-binding proteins help with the uptake of iron through the reticuloendothelial system or through the removal and reutilization of hemoglobin from erythrocytes.

Children with human immunodeficiency virus (HIV) infection have a higher prevalence of intestinal malabsorption. Anaemia is also a common feature in these children especially iron deficiency. Iron deficiency is related to intestinal malabsorption.

VI. Conclusion

This study was conducted in biochemical parameters in HIV malnourished children and normal healthy children to know the differences if any, in the levels of plasma glucose, total proteins, albumin, A/G, Total cholesterol, serum iron and TIBC in venous blood of HIV malnourished children as compared to control group. The important nutritional marker in HIV related malnutrition in children is iron. The findings of present study are as follows;

1. Plasma glucose concentrations, Serum total proteins , albumin and globulin levels, and total Cholesterol levels are significantly decreased in HIV malnourished children when compared with the controls.
2. Serum Iron levels are significantly and statistically decreased in HIV malnourished children when compared with the controls
3. TIBC levels are significantly and statistically increased in HIV malnourished children when compared with the controls
4. Serum creatinine and urea showed no significance in HIV malnourished children when compared with the controls.

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