



Original Research Article

Serum calcium and phosphorus levels in patients of HIV positive under the treatment

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ABSTRACT

Background: The abnormal levels of serum calcium and phosphorus are mostly seen in diseases of bone, kidney, tuberculosis, parathyroid diseases etc. The present study is aimed to measure the serum total calcium and phosphorous levels in HIV infected patients and in healthy controls.

Materials and Methods: This cross sectional case-control study was conducted at Department of Biochemistry, NRI Medical College and General Hospital, Chinnakakani, Guntur, Andhra Pradesh. A total of 90 HIV positive patients were taken as cases and 90 healthy subjects served as controls. Patients with congestive heart failure, liver diseases, diabetes and hypertension were excluded from the study. Seropositivity of all 90 HIV patients was confirmed by HIV TRI-DOT test. 5 ml of venous blood sample was collected after taking aseptic precautions from the study subjects. Serum was used for the estimation of Calcium by O-Cresolphthalein complexone method and Phosphorus by Fiske and Subbarow Method.

Results: In this study, HIV positive patients had significantly reduced mean serum calcium (8.02 ± 0.86 mg/dl) and phosphorous (2.68 ± 0.65 mg/dl) levels compared with healthy subjects.

Conclusion: The present study may conclude that serum levels of calcium and phosphorus were decreased in HIV positive patients, suggesting that the levels of calcium and phosphorous should be closely monitored.

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1. Introduction

Globally, 36.9 million people have been infected with human immunodeficiency virus (HIV).¹ In India around 2.1 million HIV infected people are living in 2017² and 49% people taking medications under antiretroviral therapy (ART).³ The HIV prevalence rate in India is about 0.32% and in Andhra Pradesh 0.9%.

HIV is a retrovirus and the key factors for HIV transmission in India is through sex workers, homosexual practices, drug abusers, in blood or blood products and pre-natally and via transmitters. Since 2010 the new HIV infections and AIDS related deaths have reduced by 46% and 22%.³

The duration between primary infection (virus transmission) and progression to clinical symptoms average about 10 years.⁴ Renal failure is a common disease in HIV infected patients characterized by proteinuria, hypoalbuminemia, rarely hypocalcaemia, electrolyte abnormalities and altered mineral metabolism to contribute for bone diseases, cardiovascular diseases, etc.⁵⁻⁷

HIV uses nutrients such as vitamins and minerals for its replication.⁸ This may cause metabolic disorders in future life.⁹ Calcium and phosphorous are important major elements involved in the homeostasis and abnormal metabolism of this are responsible for metabolic disorders.¹⁰ Hence, maintenance of serum calcium and phosphorous is important. The main factors to maintain the serum calcium homeostasis are parathyroid hormones; vitamin-D and calcium ion itself and some electrolytes include sodium, potassium, magnesium, chloride, bicarbonates, phosphates

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and sulphates.¹¹

In HIV positive patients bone related problems like bone pains and bone fractures are may be due to low serum calcium and phosphorus levels. Calcium is present in blood as a free form (50%), protein bound form (40%) and complexed from (10%). Protein bound calcium mostly associated with the albumin (80%) and globulin (20%).¹² The most important biological functions of calcium include cell signaling, muscle contraction, blood coagulation, activation of enzymes, formation of bone, etc. Due to low serum calcium, all the above functions get decreased.

Phosphorus is also present in blood as inorganic phosphate and it is distributed to skeleton (85%), soft tissues (15%) and in extracellular fluid (<0.1%). Most of the soft tissues contain organic phosphate.¹³ The phosphorus is an essential mineral to produce energy for the process of life. It is an essential component for blood, certain enzymes and hormones. For obtaining energy, phosphorus participates in basic biochemical mechanisms by which energy is produced for the process of life.¹⁴ Phosphate is an important essential element for adenine monophosphate (AMP) and nicotinamide adenine dinucleotide phosphate (NADP). Phosphate participates in the formation of Adenosine triphosphate (ATP). Reduced levels of serum phosphate, reduces the glycolysis and cellular functions. Muscle weakness, acute respiratory failure and decreased cardiac output may occur in low levels of serum phosphate.^{15–18}

HAART (highly active antiretroviral therapy) is started in India, based on world health organization (WHO) criteria. A medication in HAART does have mild side effects; some side effects are not even noticed by patients. Out of lipid abnormalities and metabolic bone diseases (MBD), which are now a well recognized and studied side effects of HAART. MBD is a bone disorder caused by metabolic abnormalities of calcium, phosphorus, magnesium and vitamin-D in HIV patients. These minerals are important in health of bone development and maintenance.¹⁹

Osteopenia and osteoporosis are more common bone diseases in anti retroviral therapy (ART).¹⁸ Osteopenia generally has no symptoms, bone loss is less severe and bone becomes weak and may be prone for fractures. Osteoporosis is a severe condition and people who have osteoporosis are more prone for bone fractures. Osteonecrosis is the death of bone tissue and avascular necrosis results when blood supply to the bone is completely cut off. These conditions are normally seen in a long term use of drugs for HIV in ART centres.¹⁹ Under the treatment HIV patients, medicines itself affect bone loss due to reduced “protease inhibitor activity” by drugs, when protease inhibitor activity is reduced, there is a chance to reduce vitamin-D that reduces bone strength. Hence, the present study is aimed to measure the serum total calcium and phosphorous levels in HIV infected patients and in healthy controls.

2. Materials and Methods

This cross sectional case-control study was conducted at Department of Biochemistry, NRI Medical College & General Hospital, Chinnakakani, Guntur, Andhra Pradesh. This study has been approved by the institutional ethical committee and informed consent from all study subjects was obtained. A total of 90 HIV positive patients between the ages of 20 to 60 were taken as cases and 90 healthy subjects served as controls. Patients with congestive heart failure, liver diseases, diabetes and hypertension were excluded from the study. The clinical history and other necessary details were obtained from the patients records. 5 ml venous blood sample was collected after taking aseptic precautions from the study subjects into plain vacuum tubes. Sample was left for 30 minutes at room temperature and centrifuged at 3000 rpm for 4 to 5 minutes. Seropositivity of all HIV patients was confirmed by HIV TRI-DOT test. Serum total calcium (O-Cresolphthalein complexone method) and serum phosphorus (Fiske and Subbarow Method) were estimated by using Spectrophotometer.

2.1. Statistical analysis

The results obtained were expressed as mean \pm SD. Students t was used for continuously normally distributed variables. P value <0.05 is considered as statistically significant. Statistical analysis was performed using SPSS version 18.0.

3. Results

Total numbers of subjects in this study were 180, out of which 90 were HIV positive patients as cases. In cases, 37 were males and 53 were females their age ranging between 20 to 60 years. 90 healthy subjects were selected as control group. In this, 40 were males and 50 were females and their ages ranging between 20 to 60 years as shown in Table 1. In the current study serum total calcium and phosphorous levels were significantly reduced in HIV patients compared to healthy controls as illustrated in Table 2.

4. Discussion

HIV is one of the most important clinical conditions associated with morbidity and mortality in the developing countries.²⁰

HIV is a fatal illness caused by a retro virus. Body immune system is broken down by HIV infection. It infects CD4 cells initially and gradually leads to AIDS. The antiretroviral therapy has an effect on lives of HIV infected patients. Reduced bone mineral density is a significant problem in patients with HAART.^{21,22}

The reduced levels of serum calcium, when compared with normal controls, reflected on higher prevalence of hypocalcaemia in HIV patients. It is mainly caused by

Table 1: Age and sex distribution in control & HIV patients

Group	Age (years)	No. of Males	No. of Females
Controls (90)	20 to 60	40 (44.4%)	50 (55.5%)
HIV positive patients (90)	20 to 60	37 (41.1%)	53 (58.8%)

Table 2: Comparison of serum calcium and phosphorus between healthy controls and HIV patients

Parameters	Controls (n=90) Mean \pm SD	Cases(n= 90) Mean \pm SD	P-value
Calcium (mg/dL)	9.39 \pm 0.47	8.02 \pm 0.86	<0.001*
Phosphorus (mg/dL)	3.73 \pm 0.49	2.68 \pm 0.65	<0.001*

* Statistically significant

vitamin D deficiency due to lack of quantity of parathyroid hormone secretion as low BMD and is prevalent in HIV infected subjects.²³ Therefore, the distribution of calcium from cells into blood is inadequate and inflammation due to replication of virus may also causes hypocalcemia.^{24,25}

It has been reported that, HIV infection is associated with kidney disease, linked with significant proteinuria and low serum albumin levels. Since, serum total calcium levels is closely related with serum albumin concentration. Hence, decreased albumin levels also may lead to this hypocalcemia in HIV patients.²⁶ Decreased calcium levels in HIV patients may be related to reduce levels of vitamin D.²⁷

Osteopenia and osteoporosis causing weakness of bones with different degree to which bones are weaken. These were rarely observed in HIV patients due to chronic reduced levels of serum calcium.^{28,29}

Phosphorus is a major element and is a structural component in DNA and RNA, membranes, required for metabolism and energy storage. Recently, there has been an interest in phosphate levels in HIV patients on antiretroviral treatment (ART).³⁰

In the present study serum phosphate levels were significantly reduced in HIV infection patients compared to healthy controls. This hypophosphatemia is relatively observed in HIV positive patients on antiretroviral therapy.³¹ Hypophosphatemia may result from shifting of phosphorus extracellular to intracellular space, renal excretion, decreased intestinal absorption and loss from intracellular phosphate.³²

5. Conclusion

In the present study, serum total calcium and phosphorous levels were significantly reduced in HIV infected patients than healthy controls. Hence, these minerals levels to be checked regularly in all HIV patients to prevent bone complications. The study has limited with less sample size, measurement of vitamin D levels. Hence, further large prospective studies are required to confirm these findings.

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Nil.

8. Conflict of Interest

Nil.

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