

Original Research Article

Comparative study of serum calcium and phosphorus level in pulmonary tuberculosis before and after chemotherapy

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ABSTRACT

Background: Pulmonary tuberculosis is a chronic granulomatous bacterial infection caused by an acid-fast bacillus, mycobacterium tuberculosis or tubercle bacillus. It is a potentially fatal contagious disease that can affect almost any part of the body but is mainly an infection of the lungs so it is called pulmonary tuberculosis. There are many minerals synthesized in the body in an appropriate amount for specific work. If any disease occurs in the body then mineral level imbalance, like wise in pulmonary tuberculosis calcium and phosphorus levels disturb. The changes in Calcium and Phosphorus level is considered as an important factor in pathophysiology of pulmonary tuberculosis patient.

Methods: The proposed study was conducted in Department of Biochemistry with association of Department of TB and Chest of S.P. Medical College and attached Hospital, Bikaner. There were 40 cases and 40 controls in the age groups from 15 to 50 years. We took fresh samples and performed required tests following standard protocol. By Analytical grade chemicals and standard serum Calcium and Phosphorus were estimated using enzymatic kit method by auto analyzer.

Results: The Mean±SD of serum calcium and serum phosphorus levels were found 8.688 ± 0.7155 and 2.833 ± 0.6443 before chemotherapy and 9.163 ± 0.4661 and 3.695 ± 0.3471 after chemotherapy.

Conclusions: Persons, who developed pulmonary tuberculosis disease, had increased serum calcium and serum phosphorus level after chemotherapy compared to before chemotherapy patients.

Keywords: Calcium, Phosphorus, Pulmonary tuberculosis

INTRODUCTION

Pulmonary tuberculosis (TB), in the past also called phthisis, phthisis pulmonalis. Consumption (because of the severe weight loss and the way the infection appeared to "consume" the patient), phthisis pulmonalis and white plague (because of the extreme pallor seen among those infected), Scrofula (King's evil) and pott's diseases are all terms used to refer to tuberculosis.¹ Pulmonary tuberculosis is transmitted through inhalation of infected sputum droplets or ingestion of infected milk. The

resulting lung infection called pulmonary tuberculosis. Members of mycobacterium tuberculosis complex, which includes the tubercle bacillus *M. Tuberculosis*.² Tuberculosis can get by breathing in air droplets from a cough or sneeze of an infected person. The resulting lung infection is called primary tuberculosis. Most people who are exposed to tuberculosis never develop symptoms because the bacteria can live in an inactive form in the body. But if the immune system weakens, such as in people with HIV or elderly adults, Tuberculosis bacteria can become active. In their active state, tuberculosis

bacteria cause death of tissue in the organs they infect. Active tuberculosis disease can be fatal if left untreated.³ Pulmonary tuberculosis is spreading worldwide. Tuberculosis is the second most common cause of death from infectious disease (after those due to HIV/AIDS). 75% of tuberculosis cases in developing countries are in the economically productive age group (15-50 years). One third of the world's population is thought to have been infected with mycobacterium tuberculosis, with new infections occurring in about 1% of the population each year. In 2007, an estimated 13.7 million chronic cases were active globally, while in 2013, an estimated 9 million new cases occurred. The largest incidence, with an estimated 2.0 million new cases in India. In developed countries, tuberculosis is less common and is found mainly in rural areas.⁴ Tuberculosis today infects any one by breathing in the air where a tuberculosis patient has coughed, sneezed, talked or spat. In developing countries such as in India, the fight against tuberculosis can be successfully carried out only within the setting of National Tuberculosis Control Programme.⁵

In 1994, the WHO together with the International Union against tuberculosis and lung disease launched the direct observed treatments (DOTs) strategy to fight tuberculosis⁶. Five drugs are most commonly used to treat tuberculosis: Isoniazid (H), Rifampin (R), Pyrazinamide (Z), Streptomycin (S) and Ethambutol (E).⁷ Pulmonary tuberculosis can cause permanent lung damage if not treated early. Several studies have shown that inadequate supply of essential nutrients and trace elements is associated with suppression of the numerous activities of both innate and acquired immunity and have adverse effects during infection. It is also stated that the supplementation of trace elements restores immune competence.⁸ There are many minerals synthesized in the body in an appropriate amount for specific work. If any disease occurs in the body then mineral level imbalance, like wise in pulmonary tuberculosis calcium and phosphorus levels disturb. Abnormalities of calcium,

phosphorus and other minerals are common in pulmonary tuberculosis and collectively are called disorders of mineral metabolism. Normal homeostatic regulation maintains serum level, intracellular levels and optimal mineral content in bone, intestine and kidney.⁹ Normal Blood Level - 9-11mg/dl. Serum Level of Phosphorus Normal adults 3-4 mg/dl.

METHODS

The proposed was conducted in Department of Biochemistry with association of Dept. of TB and Chest of S.P. Medical College and attached Hospital, Bikaner Rajasthan, India. The study was including 80 subjects, which comprise of 40 normal healthy subjects acted as control group. 40 subjects of patients diagnosed as suffering from pulmonary tuberculosis, between the age group 15-50 years of both sex. 5.0 ml blood of pulmonary tuberculosis patient will be drawn in a perfectly clean dry syringe preferably disposable and then transferred to clean dry centrifuge tube allowed to clot at room temperature for 30 minutes. Then blood has to precautionally centrifuged. The serum was separately by centrifugation at 3000 revolutions per minute (rpm) for 10 minutes. Samples with sign of hemolysis were discarded. Analytical grade chemicals, standard was used and the following estimation were done. Serum Calcium and Phosphorus might be estimated using enzymatic kit method by auto analyzer.

RESULTS

The blood samples of control healthy group as well as study group were withdrawn and analyzed for serum calcium (mg%) and serum phosphorus (mg%) in blood in normal healthy, before chemotherapy and after chemotherapy. The mean serum calcium level was found to be decreased to 8.688±0.7155 in pulmonary tuberculosis patient before chemotherapy as shows in the Table 1.

Table 1: comparison of mean value of calcium (mg/dl) in normal control subjects and study group before chemotherapy.

Blood Parameters (mg/dl)	Normal control subjects		Study group			
	Mean±SD	SE	Before Chemotherapy			
			Mean±SD	SE	t	P
Calcium	9.200±0.4614	0.07296	8.688±0.7155	0.1131	3.659	0.0001***

***=Highly significantly.

The low level of serum calcium in tuberculosis patient was statistically highly significant as compared to normal control group (9.200±0.9614).

It is observed from Table 3 and 4 shows that the comparison of mean value in serum calcium and serum

phosphorus level in before chemotherapy (mean value = 8.688±0.7155, 2.833±0.6443) and study group in after chemotherapy (mean value=9.163±0.4661, 3.695±0.3471) was statistically significant as evident by p value which is 0.0001 in calcium and p value which is 0.0001 in phosphorus respectively. The mean serum

calcium level was found to be increased to 9.163 ± 0.4661 in pulmonary tuberculosis patient after chemotherapy as shows in Table 3. The increase level of serum calcium in

after chemotherapy patients was statistically highly significant as compared to that of before chemotherapy patient (8.688 ± 0.7155).

Table 2: Comparison of mean value of phosphorus (mg/dl) in normal control subjects and study group before chemotherapy.

Blood parameters (mg/dl)	Normal control subjects		Study group			
	Mean±SD	SE	Before chemotherapy		t	P
			Mean±SD	SE		
Phosphorus	3.648 ± 0.4224	0.06679	2.833 ± 0.6443	0.1019	6.691	0.0001***

***=Highly significantly.

Table 3: Comparison of mean value of calcium (mg/dl) in study group before and after chemotherapy.

Blood parameters (mg/dl)	Study group				t	P
	Before chemotherapy		After chemotherapy			
	Mean±SD	SE	Mean±SD	SE		
Calcium	8.688 ± 0.7155	0.1131	9.163 ± 0.4661	0.0737	3.518	0.0001***

***=Highly significantly.

Table 4: Comparison of mean value of phosphorus (mg/dl) in study group before and after chemotherapy.

Blood parameters (mg/dl)	Study group				t	P
	Before chemotherapy		After chemotherapy			
	Mean±SD	SE	Mean±SD	SE		
Phosphorus	2.833 ± 0.6443	0.1019	3.695 ± 0.3471	0.0548	7.454	0.0001***

***=Highly significantly.

The mean serum phosphorus level was found to be increased to 3.695 ± 0.3471 in pulmonary tuberculosis patients after chemotherapy as shows in Table 4. The increase level of serum phosphorus in after chemotherapy patient was statistically highly significant as compared to that of before chemotherapy patient (2.833 ± 0.6443).

DISCUSSION

The patients suffering from TB had shown that calcium signaling is altered in macrophages infected by mycobacteria. However, in most reported cases the elevation of calcium ions that normally accompanies phagocytosis of other bacteria or inanimate particles was reduced or absent when mycobacteria were the target. The observations of Jayachandran et al.¹⁰ seem to imply that elevation of calcium ion levels is an essential component of the mechanism whereby the mycobacteria arrest phagosomal maturation.

The calcium and phosphorus level became normal of completion of therapy and the study helps in macro-minerals level changes during Tuberculosis infection and may suggest need for therapy targeted at normalizing those levels for early prognosis of the disease. This study are not resembled with the observation made by Okogun GA who observed that there was no significant statistical

difference ($P > 0.05$) in the inorganic phosphate level between tuberculosis patients and control group as well as in newly diagnosed tuberculosis patients, when compared to tuberculosis patients on treatment.¹¹

Chemotherapy for tuberculosis managed to raise serum levels of both the ions, with hypocalcemia still persisting in majority of patients during treatment but getting resolved in a significant percentage of patients at the end of 6 months of treatment. Results indicate the need for calcium and phosphorus supplements in tuberculosis patients during chemotherapy and the study also warrants the need for regular monitoring of serum calcium and phosphorus in patients undergoing anti-tuberculosis treatment.

CONCLUSION

Interestingly, variable serum calcium and serum phosphorus levels were found in pulmonary tuberculosis patients.

The mean serum calcium and serum phosphorus levels were found to be decreased significantly in pulmonary tuberculosis patient before chemotherapy as compared to that of control group. Due to malnutrition and malabsorption associated with tuberculosis resulting

hypocalcemia to impaired intestinal absorption of calcium and phosphorus or decreased active metabolites of vitamin D. The means serum calcium and serum phosphorus levels significantly increased in pulmonary tuberculosis patients after chemotherapy as compared to before chemotherapy, due to nutritional supplementation may help to improve outcome in tuberculosis patients when started during the initial phase of tuberculosis treatment, produced a significant increase in body weight, total lean mass and physical function after six weeks.

Thus, persons who developed pulmonary tuberculosis disease, had increased serum calcium and serum phosphorus level after chemotherapy compared to before chemotherapy patients. Similar results were obtained in some studies done by other researchers.

The results may be significant in understanding the possible contribution of serum calcium and phosphorus in the patho physiological process of developing the strategies for prevention and early diagnosis.

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