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Serum Zinc, Magnesium and Albumin / Globulin Ratio in Patients with Pulmonary Tuberculosis.

Kishori Lal[1], Kavita Yadav[2]

[1]Sr. Demonstrator, department of Biochemistry, Assistant Professor

[2]Department of Physiology, Govt. Medical College, Bharatpur.

Correspondance Author: Kavita Yadav, Assistant Professor, Department of Physiology, Govt. Medical College, Bharatpur.

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Abstract

Tuberculosis is considered as one of the most important infectious disease.The dietary deficiency of trace elements like zinc,magnesium and albumin/globulin ratio have been associated defective functioning of immune mechanisms in human and hence these imbalance in these elements may be associated in the pathophysiology of infectious diseases like pulmonary tuberculosis.The aim of this study to estimate and compare serum zinc,magnesium level and serum albumin /globulin ratio between pulmonary tuberculosis patients and normal subjects.Serum level of zinc,magnesium and albumin/globulin ratio were significantly reduced in pulmonary tuberculosis patient as compared to control group ($p<0.0001$ for zinc, $p<0.0001$ for magnesium and $p<0.0001$ for albumin/globulin ratio).

Keywords: Pulmonarytuberculosis, zinc, magnesium, albumin, globulin, imunity,infectious disease, elements.

Introduction

Pulmonary Tuberculosis (TB) is a disease caused by Mycobacterium tuberculosis and is a major cause of morbidity and mortality, particularly in developing countries.The 1990 Word Health Organization report on Global Burden of disease ranked TB as the seventh. [1]

The classic clinical features of pulmonary tuberculosis Include[2]

-Chronic cough,

-Sputum production,

-Appetite loss,

-Weight loss,

-Fever,

-Night sweats,

-And hemoptysis.

World TB day falling on 24 march every year,is designed to build up public awareness that Tuberculosis is remain an epidemic in much of the world,causing the death of several millions of people each year, mostly in the third World. 24 march commemorates the day in 1882 when Dr Robert Koch astounded the scientific community by announcing that he had discovered the cause of tuberculosis,the TB bacillus.Koch's discovery opened the way towards diagnosis and curing tuberculosis,so this day is celebrated as World TB day.[3]

M. tuberculosis is an aerobic, nonmotile, non-spore-forming rod that is highly resistant to drying, acid, and alcohol. It is transmitted from person to person via droplet nuclei containing the organism and is spread mainly by coughing.Unfortunately,acid-fast bacilli are found in the sputum in a limited number of patients with active pulmonary TB. [4]

A definitive diagnosis of TB is made by identifying M. tuberculosis in a clinical sample (e.g. sputum, pus, or a tissue biopsy). However, the difficult culture process for this slow-growing organism can take two to six weeks for blood or sputum culture.[5]Thus, treatment is often begun before cultures are confirmed.[6]

Magnesium

Magnesium is an essential component of body in man and other mammals.Only 0.3% of total body magnesium exists in the serum.[7]Next to potassium it is the most abundant intracellular cation of the body.[8]

Magnesium is a cofactor in more than 300 enzyme systems that regulate diverse biochemical reactions in the body, including protein synthesis, muscle and nerve function, blood glucose control, and blood pressure regulation . Magnesium is required for energy production, oxidative phosphorylation, and glycolysis. It contributes to the structural development of bone and is required for the synthesis of DNA, RNA, and the antioxidant glutathione. Magnesium also plays a role in the active transport of calcium and potassium ions across cell membranes, a process that is important to nerve impulse conduction, muscle contraction, and normal heart rhythm.[9]

Britton et al.demonstrated that a lower dietary magnesium intake was associated with impaired lung function, bronchial hyperreactivity and an increased risk of wheezing.[10]

Zinc

Zinc is an essential trace element for humans, animals and plants. It is vital for many biological functions and plays a crucial role in more than 300 enzymes in the human body. Zinc lowers the incidence of infection and inflammatory cytokines levels in healthy elderly subjects.[11]Zn supplementation to infants and pre-school children resulted in reduced incidence of acute lower respiratory infections.[12]

Zn is also known to exhibit powerful anti-oxidant activity in several organ systems including the lungs.[13,14] For example, Zn deficient rats developed significant lung toxicity 1 day after exposure to high oxygen concentrations and Zn replenishment prevented the hypoxia lung damage in previously Zn deficient animals.[15]

Micronutrient deficiencies such as zinc deficiency lead to impaired immunity and there by increase susceptibility to infections such as tuberculosis.[16,17]

Albumin/Globulin Ratio

The study of serum protein profile in chronic diseases was undertaken primarily to identify factors of prognostic significance in patients with pulmonary tuberculosis.Weak associations, though statistically significant, were observed between the extent of tuberculous disease on admission and the concentrations of $\alpha_2$and gamma-globulins and the A/G and A/ α_2 ratios.It has been well established that in chronic infectious diseases like tuberculosis,the albumin content of serum proteins shows a decrease while the globulin content shows an increase leading to low albumin to globulin (A/G) and albumin to α_2-globulin (A/ α_2) ratios.[18,19]

Material and Methods

Present study was conducted in Respiratory Medicine Department and T.B Clinic of S.P.Medical college,bikaner in 2014-15. 50 clinically diagnosed Pulmonary Tuberculosis patients will be represented as study group and 50 normal persons will be selected as control group.

The subjects will be divided in following types:-

Study Group

50 clinically diagnosed patients with pulmonary tuberculosis.

Exclusion Criteria

Smear negative cases.

Extra-Pulmonary cases.

Pulmonary tuberculosis with chronic hypertension

Pulmonary tuberculosis with Diabetes.

Pulmonary tuberculosis with heart disease.

Patients on drugs containing zinc and magnesium in their constituents was excluded from the study.

Control Group

50 normal subjects living normal life physically fit.

History was taken to be sure that the patient had fulfilled the selection criteria. Interview schedule was developed to collect the general information regarding age, socio economics status, education, dietary habit etc. A through clinical examination was carried out.

Collection of Samples

5ml blood from antecubital vein has withdrawn in a perfectly clean dry syringe and was transferred to a clean dry vial slowly by the side of the vial after removing the needle to avoid hemolysis. The blood was allowed to clot at room temperature for 30 minutes and then transferred to a centrifuge tube. The serum was separated by centrifugation at 3000 rpm for 10 minutes.

Estimation of Serum Magnesium and Zinc

The serum serum magnesium and zinc were estimated by atomic absorption spectorphotometer (AA-7000) as described by Fernandez et al (1971), in the department of Biochemistry, S.P. Medical College, Bikaner.

Principle

In flame atomic absorption spectroscopy a liquid sample is aspirated and mixed as an aerosol with combustible gases (Air-C_2H_2 or C_2H_2-N_2O). The mixture is ignited in a flame of temperature ranging from 2100 to 2800.C (Depending on the fuel gas used). During combustion, atoms of the element of interest in the sample are reduced to the atomic state.

Estimation of Serum Magnesium:

The serum magnesium was estimated by AAS (AA-7000) by the procedure as described above.

Estimation of serum Zinc

The serum zinc was estimated by AAS (AA-7000) .

Estimation of A/G Ratio

A) Estimation of Serum Protein

Principle

Peptide bonds of proteins react with copper (II) ions in alkaline solutions to form purple coloured product whose absorbance is measured spectrophotometrically at 540 nm.

Procedure:

Label three test tubes as B for Blank, T for Test and S for Standard. Mix the contents of the tubes thoroughly. Wait for 15 minutes and take the readings using a spectrophotometer at 540nm. Calculate the concentration in g/dL of total protein in the given serum.

B) Estimation of Serum Albumin

Principle

Albumin binds quantitatively with bromocresol green (BCG) at pH 4.15 resulting in the formation of a green colour which shows maximum absorbance at 630 nm.

Procedure:

Pipette out 0.2mL of serum into a test tube. Add 1.8mL distilled water to it to achieve a dilution of 1 in 10. Dilute the standard protein in a similar way. Add the solutions to individual test tubes marked Blank, Standard and Test as indicated the in the table below.

Mix all tubes by tapping them, one by one, against the palm. Let stand for 10 minutes at room temperature, take the reading in a spectrophotometer at 630nm. Calculate the concentration of serum albumin and determine the A/G ratio in sample.

Result

Table 1. Comparison between Normal Healthy Persons (Control Group) and Pulmonary Tuberculosis patients (Study Group) according to their age.

Age group	Control Group		Study Group	
	Number of Subjects	Percentage	Number of Subjects	Percentage
31-40	21	42	14	

				28
41-50	15	30	15	30
51-60	09	18	14	28
61-70	05	10	07	14
Total	50	100	50	100

Table 2. Comparison of Mean Serum Magnesium (mg %) and Mean Serum Zinc Concentration (µg %) in Pulmonary Tuberculosis Patients (Study Group) with Normal subjects (Control Group).

Blood parameters	Normal subjects(Control Group)			Pulmonary Tuberculosis Patients(Study Group)			Significant
	Mean±SD	Range	SE	Mean±SD	Range	SE	P
Serum Mg (mg %)	2.06±0.36	1.37-2.85	0.05	1.35±0.17	1.06-1.66	0.024	<0.0001
Serum Zn (µg %)	97.01±19.99	60.70-1.45	2.85	63.46±9.54	49.70-92.70	1.35	<0.0001

TABLE 3.Comparison of Mean Serum Albumin/Globulin Ratio in Pulmonary Tuberculosis Patients(Study Group) with Normal subjects(Control Group).

Values	**Normal subjects(Control Group)**	**Pulmonary Tuberculosis Patients(Study Group)**
Mean	1.79	1.16
Range	1.42-2.45	0.62-3.90
SD	0.25	0.49
SE	0.036	0.07
P <0.0001		

The present study show the result in table no. 2 show the comparison of mean value of serum Zinc (µg%) level between control group(97.01±19.99) & study group (63.46±9.54) and are highly significant (p<0.0001) and comparison of Mean value of serum Magnesium Concentration (mg%) in highly significant (p<0.0001) in between two groups and in table no.3 show the Mean+SD value of serum Albumin/Globulin ratio (1.79±0.25) in control group & mean+SD value in study group is (1.16±0.49) and comparison between control & study group are highly significant (p<0.0001).

Dicussion

The present study observed the comparison of mean value of serum Zinc(µg%) between control and study groups and are highly significant (p<0.0001).Cuevas and co-workers in the united Kingdom studied on the effect of zinc on the tuberculin response of 98 children exposed to adults with smear positive tuberculosis.They found a higher proportion of children as PPD positive in the zinc-supplemented group(57.1%) than in the placebo group(53.1%).[20]

Pulmonary tuberculosis patients had low serum concentration of zinc.This was likely due to the redistribution of zinc from plasma to other tissues,a reduction of the hepatic production of the zinc –carrier protein a-macroglobulin and a rise in the production of metallothionin, a protein that transports zinc to the liver.[21]

The present study observed the comparison of mean value of serum Zinc(µg%) between control and study groups and are highly significant (p<0.0001).

The present study observed the comparison of mean value of serum magnesium (mg%) between control and study groups and are highly significant (p<0.0001). According to Biswajit das study also observed serum magnesium concentration were found to be markedly low in those cases that had far advanced than in those with moderately advanced disease.[22].

The present study observed the Mean±SD value of serum Albumin/Globulin ratio is (1.1580.4871)and comparison are highly significant (p,0.0001).Gilliland[18]suggested that the A/α2 ratio could be employed to assess the activity of the disease and to monitor the progress of the patient

during chemotherapy. The α2 –globulin fraction consists of a number of proteins with similar electrophoretic mobilities, some of which like ceruloplasmin are acute phase proteins.The concentrations of these proteins are known to be increased in response to inflammatory reactions involving tissue damage and infection.[23]

Conclusion

Tuberculosis is an important global health problem.Tuberculosis remains the number one killer infectious disease affecting adults in the developing countries.World Health Organization report on Global Burden of disease ranked TB as the seventh in 1990. In our study showed the decreased serum Zinc,Magnesium and Albumin/Globulin ratio reflecting the ongoing inflammatory process and imbalance in these elements may be associated in the pathophysiology of infectious diseases like pulmonary tuberculosis.

The estimation of serum Zinc, Magnesium and Albumin/Globulin ratio can have an auxillary value in the early diagnosis and in monitoring the prognosis of pulmonary tuberculosis patients. Serum Zinc, Magnesium and Albumin/Globulin ratio could serve as a diagnostic tool and also assess beneficial effects of anti-tuberculous therapy,but further larger group studies is necessary.

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