Effects of Anti-Tuberculosis Drugs on the Level of some Nutritional Factors among Patients with Tuberculosis

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Abstract

Objectives: The study aimed to assess changes in the level of some nutritional elements including zinc and copper for tuberculosis patients before, during and after anti- tuberculosis therapy.

Methods: Whole blood samples are collected from 120 tuberculosis patients who are admitted to specialist clinic of the respiratory diseases in Babylon province, within a period from November 2020 to January 2021.

Results: Out of whole TB patients, (66) ones were males and the remaining (54) were females, the age of patients ranging from (13–70) years. Sixty, apparently healthy control groups who had no Tuberculosis history were chosen. Using spectrophotometer for estimating the level of Zinc and copper. In TB patients the zinc level was increased during and after anti-tuberculosis therapy, but the level of zinc lower in patients after therapy compared with controls. The level of copper was decreased during and after the course of anti-tuberculosis, but the level of copper higher in patients after therapy compared with controls.

Conclusion: These parameters could be used in follow-up as the achievement of TB therapy success.

Keywords: Copper, zinc, *M. tuberculosis*, anti-tuberculosis

Introduction

Tuberculosis (TB) is one of the primary considerable causes of sickness and mortality. As along many decades, the numbers of TB cases had been increased significantly worldwide. Human immune response has a potential implication in the control and prevention of TB disease, thus it is so essential to comprehend its regulation; especially the cell-mediated immune response that influenced the main response of the host against *M. tuberculosis*, in which important role is attributed to cytokine and T helper-1 cells.[1]

Many factors can affect this response, one of them is the micronutrients, copper, and zinc have a vital role in the growth, differentiation, and proliferation of cells of acquired and innate immunity. Both these nutrients play a crucial role in the resistance of the human body to certain infections as tuberculosis.

As an influence of reduced zinc level, which causes shifting in the function of macrophage and reduces the production of interferon-γ (INF-γ) and tumor necrosis factor (TNF-α). This reduced zinc concentration may be also responsible for the reduction of the differentiation and proliferation of B and T lymphocytes. The changes in the immunity dynamics would be the first line in the presentation of the immune system to protect against active tuberculosis. Additionally, a quick cure of adult patients with active TB could be achieved by supplementation of zinc and vitamin A as they allow thorough elimination of Mycobacterium.[2] Vemula et al. showed that micronutrients deficiency enhances the ability of mycobacterium to produce *M. tuberculosis* Zinc metalloprotease-1 (Zmp1), which is crucial for their pathogenesis and intracellular survivals with immunogenic potential.[3]

Regarding copper, it has a role in the biological systems due to its existence in the composition of many active biological enzymes that act in reductive and oxidative reactions, as metallothioneins lysyl oxidase, ceruloplasmin, cytochrome oxidase, and SOD. In spite of its biological and physiological assistances, its excessive level is toxic and might cause inhibition of *M. tuberculosis* growth.[4]

Materials and Methods

The population of study-involved tuberculosis (TB) patients admitted to specialist clinics of the respiratory diseases in Babylon province, within a period from November 2020 to January 2021. Out of whole TB patients, (66) ones were males and the remaining (54) were females, the age of patients ranging from 13 to 70 years. The exclusion criteria: Any patients have Diabetic Mellitus, malignancy, allergic and pregnant women left out from the study. As well, sixty apparently healthy groups who had no Tuberculosis previously.

The Sample Collection

For serological studies the serum was separated; three ml of the blood sample was allowed to clot for about fifteen min. After that loosed the clot from a wall of the tube, at room temperature. Then, the sample centrifuged for 10 min at 2500 rpm. As a final point the serum transported to another tube for storage at –20°C.

Methods

Using spectrophotometer for estimating the level of Zinc and copper (LTA-Italy).

Statistical Analysis

This study used a statistical analysis that included the calculation of mean values and SD. For *P* value used independent samples *t*-tests, and the level *P* < 0.05 is significant. The statistical analysis used (SPSS Inc., Chicago, USA) version 18.

Results

A- Level of Zinc during and after Therapy for TB Patients and Controls

The mean and SD of zinc for untreated TB patients (35.507 ± 9.876) µg/dl then (55.162 ± 9.941) µg/dl during therapy and (63.212 ± 8.752) µg/dl after complete course of anti-tuberculosis therapy. While (74.350 ± 7.260) µg/dl for control groups, Table 1.

Also, this study found that the means of zinc no significantly lower in patients after therapy (63.212 ± 8.752) µg/dl compared with control group (74.350 ± 7.260) µg/dl, Table 2.

B- Level of Copper during and after Therapy for TB Patients and Controls

The mean and SD of copper for untreated TB patients (158.518 ± 28.561) µg/dl then (119.527 ± 22.026) µg/dl during therapy and (109.871 ± 26.547) µg/dl after a complete course of anti-tuberculosis therapy, Table 3.

Also, in this study found that the means of copper significantly higher in TB patients after therapy (109.871 ± 26.547) µg/dl compared with control groups (85.277 ± 7.907) µg/dl, Table 4.

Discussion

Zinc is a micronutrient that is necessary for the typical activities of the immune system.[5] Zinc aids in the bacterial destruction by the immune system cells, such as tubercle bacilli. Thus reduced Zinc level enhances infections; in TB and TB-HIV infected patients there were decreased levels of zinc in their blood samples. This regulation can occur at the transcriptional level, via DNA-binding metal-responsive transcriptional repressors which are responsible for the regulation of the transcription process as in many bacteria as *M. tuberculosis*.[4]

From the results was found the means of zinc increased gradually during anti-tuberculosis and after therapy. The result was in agreement with a study of [6] who found that a lessened concentration level of serum Zn at the initial stage of treatment when compared to control, in men and in women ($P < 0.05$). After the course of treatment, it was showed a significant increment in the level of serum Zn when it compared to untreated patients. This could occur due to change in the distribution of zinc flowing through out further tissues including the liver; this is due to a reduced production of α-2-macroglobulin in the liver; this protein carry zinc in the blood,

to get advantage of high production of this protein, it carries zinc to the liver.[6]

The result was matched with the study of [6] who found that no significant difference in the mean Zinc ($P = 0.415$) levels between Tuberculosis patients who have completed Anti-Tuberculosis Treatment 80.48 and Healthy groups 86.42. Another study was showed lower concentration of zinc was observed when compared to normal values.[6]

From the results was found the means of copper decreased gradually during anti-tuberculosis and after therapy. The result was matched with the study of [7] who mentioned that the serum level of copper in the patients under anti TB treatment was significantly decreased. The result was matched with[8] who showed that a lower concentration of copper in TB patients was observed when it compared to normal values.

The high concentration of copper in TB patients could be explained logically. As the decrement in levels of zinc, which occurs in TB patients, could prevent the entering of the copper into the tissues, and this may lead to the elevation in the level of serum copper. While increment in the levels some metals as cadmium or copper leads to poorer absorption of serum iron that is in agreement with this study.[9] ◼

Table 1. Zinc level in the serum for TB patients

Untreated patients	During therapy	After therapy
35.507 ± 9.876	55.162 ± 9.941	63.212 ± 8.752

Table 2. Level of zinc in TB patients and controls

Studied groups	Mean ± SD	P value
After therapy patients	63.212 ± 8.752	0.434
Controls group	74.350 ± 7.260	

Table 3. Copper level in the serum of TB patients

Untreated patients	During therapy	After therapy
158.518 ± 28.561	119.527 ± 22.026	109.871 ± 26.547

Table 4. Level of copper in TB patients and controls

Studied groups	Mean ± SD	P value
After therapy patients	109.871 ± 26.547	0.002
Controls group	85.277 ± 7.907	

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