Serum Zinc Level in Patients with Pulmonary Tuberculosis

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Abstract: This descriptive case series study was conducted to determine the level of serum zinc level in patients with pulmonary tuberculosis. A total of 117 newly diagnosed patients with pulmonary tuberculosis presented during six months study period at the tertiary care teaching hospital were selected by non-probability convenient sampling technique. These patients were further assessed for their serum zinc status. The assessment and judgment was done according to the cut off values of serum zinc i.e. 11-19 mmol/L. Among 117 patients of freshly diagnosed pulmonary tuberculosis, 89 (76.01%) were males. The most frequent age group in the present study was 31-40 years consisting upon 50 (42.74%) patients. The mean ±SD age of study population was 36.5±9.2 years. Serum zinc levels were low in 109 (93.16%) subjects and normal in the remaining 8 (6.84%) subjects. The mean serum zinc level of study population was 9.24±0.92 mmol/L. No statistically significant association was observed between serum zinc level and sex of the study population (P=0.22). Age was found to be highly significant statistically (P=0.002) with serum zinc status. The high percentage of zinc deficient patients of pulmonary tuberculosis promotes that estimation of serum zinc levels can be an important tool in treatment of pulmonary tuberculosis. Lowering of serum zinc levels with progression of age suggest that zinc intake (dietary or supplementary) can prevent or lower the disastrous effects of this infectious disease.

Key words: Pulmonary tuberculosis • Serum zinc • Age • Sex • Infectious disease • Immunity • Sindh

INTRODUCTION

Tuberculosis (TB, which can also stand for tubercle bacillus) is a common and often deadly infectious disease caused by mycobacteria. In humans, Mycobacterium tuberculosis is the primary causative bacterium, although other mycobacteria such as Mycobacterium bovis, Mycobacterium africanum, Mycobacterium canetti and Mycobacterium microti are also involved [1]. Although one third of the world’s population is infected with mycobacterium tuberculosis [2], the proportion of people in the general population who become sick with tuberculosis each year is stable or falling worldwide but, because of population growth, the absolute number of new cases is still increasing [2].

Despite the fact that World Health Organization (WHO) in its effort to control TB, declared it a global emergency in 1993, TB still continues to account for the largest burden of mortality by any infectious agent worldwide. It is the second leading cause of adult death in impoverished communities of Karachi [3]. Globally, Pakistan ranks the 8th in terms of estimated number of cases by WHO, with an incidence of 175/100,000 persons [3]. Pakistan alone accounts for 44% of total TB burden in the Eastern Mediterranean Region of the world comprising 23 countries [3]. In India, approximately 4.8 million people are suffering from TB infection, of which 2.2 million are smear positive; the annual risk of infection is 1 to 2% and the case fatality rate is 24% [4].

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Weight loss is one of the fundamental signs; however, malnutrition and wasting are also associated with TB infection [5]. Micronutrient deficiencies such as zinc deficiency lead to impaired immunity and thereby increase susceptibility to infections such as tuberculosis [6, 7]. Zinc deficiency affects host defense by detaining phagocytosis and reducing the number of T cells. Several studies have demonstrated that the serum levels of zinc decrease significantly during active tuberculosis and increase following recovery after institution of antituberculous therapy and improvement of the nutritional status [8-13].

Because of limited data on serum zinc level in patients with pulmonary tuberculosis, it was decided to evaluate the status of serum zinc level in patients with pulmonary tuberculosis at a tertiary care center.

**Patients and Methods:** This six months descriptive case series study was conducted at a tertiary care teaching 1500 bedded hospital of Sindh on the patients who came with history of chest pain, coughing up blood and a productive prolonged cough for more than three weeks, fever, chills, night sweats, appetite loss, weight loss, pallor and often a tendency to fatigue very easily through outdoor patient department (OPD) or indoor patients or casualty outdoor department (COD). The inclusion criteria of the study were; patients diagnosed freshly with pulmonary tuberculosis, should be of ≥12 years of age and of either gender while the exclusion criteria were patients who are already on anti-tuberculous therapy, non-tuberculous pulmonary infections, extra pulmonary tuberculosis. The serum zinc levels are affected by many physiological and pathological states and drugs, subjects with the following conditions were excluded from the study: a) Pregnancy b) Women on oral contraceptives, c) Chronic liver disease, d) Chronic renal failure, e) Myocardial infarction, f) Metastatic carcinoma, g) Nephrotic syndrome, h) Malabsorption Syndrome, i) Cystic fibrosis and j) Patients taking zinc as medication. An informed consent was obtained from every patient after full explanation of the procedure. Detailed history was taken; complete physical and relevant clinical examinations were performed. The diagnosis of tuberculosis was made through early morning sputum for acid-fast bacilli (AFB) for 3 days, or through chest radiographs (cavitations). All the routine blood investigations, sputum and chest radiographs were reviewed by a panel of expert consultant physicians of the ward and decided whether there was or no tuberculosis.

After that all such patients who were diagnosed/labeled as tuberculosis were further assessed for their serum zinc status and for that 2 ml venous blood sample was taken in a disposable syringe and sent to the laboratory for analysis. The assessment and judgment were done according to the cut-off values/readings mentioned in the operational definition. The data of all such patients were collected on pre-designed proforma.

The data were collected, the frequency and percentage of serum zinc status (low, normal, raised) in pulmonary tuberculosis were obtained by entering, saving and analyzing such data in SPSS version 10.00. The variables of the study were age, gender, serum zinc level. The descriptive statistics were used to calculate frequency, percentage, mean and standard deviation by analyzing the study variables. The mean ± SD is calculated for serum zinc level and age. The chi-square test was applied between categorical variables (gender distribution), student t-test was applied at 95% confidence interval on serum zinc level and the P-value =0.05 is considered as statistically significant.

**RESULTS**

A total of one hundred and seventeen patients of freshly diagnosed pulmonary tuberculosis were recruited and studied. Among 117 patients there were 89 (76.01%) males and 28 (23.99%) females. The age range of study subjects was 15-57 years. The most frequent age group in the present study was 31-40 years consisting upon 50 (42.74%) patients, followed by 26 (22.22%) patients in age group of 41-50 years. The mean ±SD age of study population was 36.5±9.28.

It was observed that out of the investigated 117 subjects, 109 (93.16%) presented with low serum zinc concentrations and only 8 (6.84%) subjects presented with normal serum zinc levels; no case of raised serum zinc level was encountered in the present study, as detailed in Table 1. The mean serum zinc level of the study population was 9.24±0.92 mmol/L. No statistically significant association was observed between serum zinc level and sex of the study population (P=0.22). The mean ± SD serum zinc level of males was 8.42 ± 1.84 mmol/L while in females it was 9.03±1.52 mmol/L, p=0.22 (Table 2). In the present study, association between serum zinc levels and age was evaluated and it was observed that these levels were lower with the advancement in age. This association, when calculated, was found to be statistically significant (P=0.003) as detailed in Table 3.
Table 1: Serum Zinc Status of the studied patients (n=117)

<table>
<thead>
<tr>
<th>Serum Zinc Status</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>109</td>
<td>93.16</td>
</tr>
<tr>
<td>Normal</td>
<td>08</td>
<td>6.84</td>
</tr>
<tr>
<td>Raised</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Mean ±SD serum zinc level = 9.24±0.92 mmol/L

Table 2: Serum Zinc Levels in relation to gender of the studied patients (n=117)

<table>
<thead>
<tr>
<th>Sex</th>
<th>Serum Zinc Mean (mmol/L)</th>
<th>SD (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>8.42</td>
<td>1.84</td>
</tr>
<tr>
<td>Female</td>
<td>9.03</td>
<td>1.52</td>
</tr>
</tbody>
</table>

P=0.22 (non-significant)

Table 3: Serum Zinc Levels in relation to age of the studied patients (n=117)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Serum Zinc Mean (mmol/L)</th>
<th>SD (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 21 years</td>
<td>10.97</td>
<td>0.96</td>
</tr>
<tr>
<td>21-30 years</td>
<td>10.34</td>
<td>1.16</td>
</tr>
<tr>
<td>31-40 years</td>
<td>9.52</td>
<td>0.87</td>
</tr>
<tr>
<td>41-50 years</td>
<td>8.01</td>
<td>1.04</td>
</tr>
<tr>
<td>&gt;50 years</td>
<td>7.36</td>
<td>0.63</td>
</tr>
</tbody>
</table>

P=0.003 (highly significant)

DISCUSSION

The present study was carried out to document serum zinc level in patients suffering from pulmonary tuberculosis. It was observed in this study that the male population dominated female population among study subjects. A large majority (76%) of newly diagnosed patients of pulmonary tuberculosis presented at a tertiary care hospital of Sindh was male. Other studies also reported similar observations. A study conducted at Lucknow, India reported that 73.41% of the study population consisted of males [14]. A study from Indonesia also reported a large majority of study population as males [15]. However, a Pakistani study as well as an other Indian study observed different scenarios. Both of them reported an equal ratio of gender [16, 17]. An interesting fact was noted that both of these studies were conducted at Northern areas of their respective countries.

The overall mean age of patients with pulmonary tuberculosis in the present study was 36.92±11.3 years. Ramakrishnan et al. [18] also reported similar results. The mean age of subjects in this study was 35.3±11.3 years. The observation made in a study conducted by Duzova et al. [19] reported that the mean age of pulmonary tuberculosis cases in their study was 31.85±7.39 years. However, it was noted that the sample size in their study was quite small.

Serum zinc levels of patients with pulmonary tuberculosis was evaluated in this study and it was demonstrated that these 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 a2-macroglobulin and a rise in the production of metallothionin, a protein that transports zinc to the liver. It was recorded that more than 93% of subjects in the present study had the serum zinc level below cut-off value (11 mmol/L) and only about 7% study subjects presented serum zinc level within reference range (11-19 mmol/L). In the present study the mean serum zinc level recorded among study population was 9.24±0.92 mmol/L. Duzova et al. [19] documented similar reports. They reported that the mean serum zinc level in study subjects was 9.49±1.2 mmol/L. Concurrently, A former study [14] reported that the mean serum zinc level among patients with pulmonary tuberculosis was 9.7±1.9 mmol/L. A study from Kashmir, India, has reported somewhat higher mean serum zinc level in patients with pulmonary tuberculosis (10.44±0.82 mmol/L) [17] Similar to that another study reported mean serum zinc level of 10.03±1.5 mmol/L in patients of pulmonary tuberculosis [18]. A study from Japan reported higher mean serum zinc level (12.39±2.17 mmol/L) in patients with pulmonary tuberculosis [20]. In spite of this variable contrast in the mean serum zinc levels, it was noted that all these studies reported low zinc levels in sera of larger majority of pulmonary tuberculosis patients.

In the present study, association between sex and serum zinc level in patients with pulmonary tuberculosis was also evaluated. The mean serum zinc level in male subjects of the present study was 8.42±1.84 mmol/L and in female subjects was 9.03±1.52 mmol/L. Any significant association between sex and serum zinc level was not observed in patients of pulmonary tuberculosis (P=0.22). In line to this, a study also reported that no significant association was observed between sex and serum zinc level in patients of pulmonary tuberculosis. Similarly Khanna et al. [14] also observed that sex and serum zinc level were not associated statistically in patients with pulmonary tuberculosis.

Association of age with serum zinc level in patients with pulmonary tuberculosis was evaluated in the present study. Diminished serum zinc level was demonstrated in the present study. Such a discrepancy in patients of pulmonary tuberculosis was statistically proved to be
highly significant. In accordance to these results of the present study another study reported that serum zinc levels revealed an inverse relationship with age in patients with pulmonary tuberculosis, which was highly significant statistically [17]. It was reported in this study that lowered serum zinc levels were observed with advancement in age. However, other studies reported in contrast. A study published in 2006 [20] observed that there was no significant association between age and serum zinc level in patients of pulmonary tuberculosis. In another study from Lucknow, India, it was reported that there was no association of age with serum zinc level in patients with pulmonary tuberculosis [14]

CONCLUSIONS

The majority of pulmonary tuberculosis cases presents with low serum zinc concentration, which promotes that estimation of serum zinc levels is an important tool in treatment of pulmonary tuberculosis. Zinc supplementation is suggested to be a mandatory constituent of the treatment protocol.

REFERENCES


