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Serum Level of Trace Elements (Zinc, Lead, and Copper), Albumin and Immunoglobulins in Asthmatic Children

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Abstract

***Background*:** Bronchial asthma (BA) is a chronic inflammatory disease and it is a major health problem. Trace elements such as copper and zinc are essential components of anti-oxidant enzymes and optimal function of the immune response. Changes in the levels of these elements may lead to increase the risk of asthma.

***Materials and Methods*:** The study group consisted of 175 asthmatic children and 165 control group of healthy general population who attend the outpatient allergic clinic (Bou Ali Hospital) in Sari, Mazandaran, Iran between August 2010 and March 2011. Complete blood count, eosinophil count and serum total IgE level and Serum trace element levels (Zinc, lead and copper) were measured in both groups.

***Results*:** There was a significant difference in serum levels of copper, lead, IgE (increased), and decreased IgA, between two groups (p=0.001). There was no significant difference in blood zinc levels and eosinophilia between two groups (p=0.732 and 0.068, respectively).

***Conclusion*:** Increased serum levels of copper and lead may be associated with asthma.

Introduction

Bronchial asthma (BA) is a chronic inflammatory disease and it is a major health problem. Different genetic and environmental factors are known to be responsible in the pathogenesis of asthma [1]. It has been suggested that there are some defense mechanisms to escape from the effects of oxidant radials. A number of researches have reported that BA tends to have higher levels of oxidative stress [2]. As for anti-oxidants, there are various enzymes eliminating over produced reactive oxygen species (ROS), superoxide dismutase (SOD) and glutathione peroxidase. SOD has copper (CU) and zinc. Traces elements exist in very low concentrations in the body, consisting at 0.01% of the total body weight [3] and they show many physiological functions such as immunomodulatory effects. Trace elements such as copper and zinc are essential components of the anti-oxidant enzymes. Furthermore copper is also required during oxidant with increase of free radicals production and consequently increase risk of asthma [4]. Zinc and copper are involved in cell and tissue growth. Zinc plays an important role in DNA and protein synthesis. The epidemiology of pediatric asthma and that of lead poisoning are strikingly similar [5].

Lead excess may result in alteration of the immune system which is known to be associated with asthma and IgE increasing [6]. All the mechanisms mentioned above suggest that copper and zinc are important elements in oxidant/antioxidant path ways and therefore have a critical role in patients with BA. A number of studies reported have shown the association and or correlation between serum trace elements and asthma disease [7]. Trace elements deficiency leads hyperactivity and inflammation in respiratory tract system. Zinc obtainable from protein-rich foods such as red meats, seafood, fresh fruits, vegetables and dairy products [8]. The aim of this study was to compare the serum levels of trace elements (zinc, lead and copper) and albumin in mild persistent asthmatic patients and healthy controls.

Materials and Methods

The study group consisted of 175 asthmatic children (mild persistent) who attend the outpatient allergic clinic (Bou Ali Hospital) in sari between august 2010 and March 2011 and 165 healthy controls selected from general population. The study was approved by ethic committee of Mazandaran University of Medical Sciences, Sari, Iran. Demographic data were record in questionnaire form. The control group was healthy people that they had not any disorder based on history, physical examination. Also we try to find a relative person that they have more match especially food intake. None of the case patients had diabetes mellitus, liver or kidney disease, infection or thyroid dysfunction. In addition, we excluded everybody take any supplementation of trace elements in both group. Also we exclude moderate or severe asthmatic patients and who toke any corticosteroid in one month ago. The diagnostic criteria of BA are based

on the history, family history, and physical examination and also laboratory data. Pulmonary function tests were performed to all patients. Chest radiography, complete blood count, eosinophil count and serum total IgE level was performed in all patients. All patients in this study stop inhaled steroids (low dose fluticasone+salmeterol) for one month before examination. Serum trace element levels (zinc, lead and copper) and albumin were measured in both groups. Serum was determined from the 2 groups of peripheric venous blood samples and samples were kept at preserved at -70ºC. Serum Zn and Cu levels were measured by flame atomic absorption spectroscopy. (Zeeman, Varian, Australia). Serum zinc, lead and copper was expressed in µg/L.

Statistical analysis

All results were given as the mean ± standard deviation value and data analyses were performed by SPSS-13 statistical programmed. Results were compared with Students *t*-test analysis and $p<0.05$ value was considered as statistically significant.

Results

The study included 175 patients with BA and 165 healthy controls (Table 1).The BA group consisted of 98 females and 77 males, The age of the patients ranged from 3 to 19 years old (mean±SD: 10.28±8.60 years old). Duration of asthma was between 1 year to 14 years old.

The control group consisted of 87 female and 78 males; their ages ranged from 3 to 19 years. (11.40±7.55 years old). Albumin, zinc, copper, lead, IgA, IgE serum levels and eosinophil count are shown in table 2.

There is a significant difference in the values of IgA, IgE, copper and lead between two groups ($p=0.001$). IgE, copper and lead levels were significantly increased in asthmatic patients than healthy control group. Serum level of copper was not difference between males in two groups.

There was no significant difference in the values of zinc end eosinophilia between two groups

Zn/Cu ratio was significantly reduced in BA groups than group ($p=0.017$); 0.722± 0.372 µg/L, 0.869±0.341 µg/L respectively. Also, there was significant decrease in serum albumin levels in BA group ($p=0.001$). The mean concentrations of IgA, IgE, copper and lead were found to be significantly higher in asthmatic group ($p=0.001$).

There was significantly difference in the values of eosinophil (increased count) and increasing of IgE in asthmatic males than normal males (Table 3).

There is significant difference in the values of IgE, copper and lead in BA females compared with normal females (Table 4). There was not hypo-IgA (level<10 mg/dl) in our patients and normal population.

Table 1. Age and gender distribution in asthmatic and healthy groups

Age (years)	BA group N(%)	Healthy group N(%)	Total N(%)
3-5	30(9)	23(6)	53(15)
5-9	64(19)	54(16)	118(35)
10-14	47(15)	51(15)	98(30)
15-19	36(10)	37(10)	73(20)
Total	175(53)	165(47)	340(100)
Male	77(19)	78(20)	155(39)
Female	98(34)	87(27)	184(61)

Table 2. Distribution of serum levels of copper, zinc, lead, IgE, and eosinophil count in asthmatic and healthy groups

Groups/tests	Asthmatic groups (N=75)	Healthy group (N=65)	*p*-Value
Eosinophil (>450)	23 (13%)	8 (5%)	0.068
Albumin(gr/dl)	4.32±0.040	4.78±0.27	0.001
IgA (Mean±SD) (mg/dl)	217.61±98.12	184.14±51.77	0.012
IgE (Mean±SD) (µl/ml)	221.30±200.52	83.56±88.57	0.001
IgE (>100 µl/ml)	146 (61%)	112 (18%)	0.001
Copper (Mean±SD) (µg/dl)	122.04±31.05	105.13±77.99	0.001
Lead (Mean±SD) (µg/dl)	4.98±3.11	3.35±1.64	0.001
Zinc (Mean±SD) (µg/dl)	83.08±44.96	85.06±20.35	0.752

Table 3. Compared levels of copper, zinc, lead, IgE and eosinophil in males between asthmatic (N=75) and healthy (N=28) groups

Groups/ tests	Asthmatic groups	Healthy group	*p*-Value
Eosinophil (>450)	17(86%)	3(14%)	0.043
Zinc (Mean±SD <µg/dl)	92.25±72.01	91.14±19.58	0.938
IgA (Mean±SD) (mg/dl)	232.92±122.97	184.39±44.25	0.062
IgE (Mean±SD) (IU/ml)	215.25±175.05	68.39±63.25	0.001
IgE (>100 µl/ml)	43(56%)	9(11%)	0.001
Copper (Mean±SD) (µg/dl)	115.48±28.25	112.10±31.92	0.680
Lead (Mean±SD <µg/dl)	5±2.46	3.68±1.83	0.025

Table 4. Compare levels of copper, zinc, lead, IgE and eosinophil in females between asthmatic (N=48) and health (N=37) groups

Groups/tests	Asthmatic groups	Healthy group	*p*-Value
Eosinophil (>450)	8(8%)	4(5%)	0.597
Zinc (Mean±SD) (µg/dl)	77.91±15.44	80.45±57.42	0.524
IgA (Mean±SD) (mg/dl)	209.00±81.13	184.43±57.42	0.0106
IgE (Mean±SD) (IU/ml)	224.69±215.22	95.05±102.98	0.001
IgE (>100 IU/ml)	64(65%)	21(24%)	0.028
Copper (Mean±SD) (µg/dl)	125.72±32.21	99.86±23.70	0.001
Lead (Mean±SD) (µg/dl)	4.98±3.45	3.14±1.48	0.002

Discussion

Different studies have been suggested that trace elements might be involved in inflammatory process such as asthma. Variations in trace elements such as lead, zinc and copper occur during of acute and chronic inflammatory such as BA. Furthermore, zinc and copper are required for optimal activity of the immune system [9]. This study assessed the serum levels of lead, copper, zinc, IgE, IgA and albumin levels in BA compared with healthy group.

Similar to other studies, our study showed copper concentration is significantly higher in BA group compared to healthy group [10, 11]. Our results are consistent with Sagdic et al., indicated that there was no significant difference in zinc level between patients and controls, while there was an increase in copper level in asthmatic patients [12]. In contrast to our results, Hussein et al showed the mean concentrations of copper were significantly lower in patients compared to controls [13].

In the current study we could not find any difference in zinc serum levels between two groups which is consistent with other studies [14]. Zinc/copper ratio was significantly decreased in BA patients which might be due to increase in copper concentration. Although, in some studies, serum zinc level deficiency has been associated with increase allergic disorders such as asthma [11, 15]. In contrast to other studies, Hussein et al showed that serum zinc level was found to be elevated in their asthmatic patients [13]. Therefore, there are controversial data regarding serum levels of copper and zinc in asthmatic patients. Thus it seems likely that a decrease in the ratio of zinc to copper is more important than the variation in zinc or copper levels.

In our study, although there was significant difference in serum level of copper, lead and albumin between asthmatic group compared healthy group but there was no significant difference in serum level of zinc, copper and lead between male and female in asthmatic group but Anetor et al., study showed that copper levels were significantly higher in female asthmatics than in males [16]. Low level of copper may be associated with decrease in SOD activity [17] which leads to remove free radicals in respiratory system.

Our results demonstrated the serum levels of IgE and lead was significantly higher in patients compared with control groups. The effects of environmental lead exposure on the human immune system have been reported. There is a positive correlation between IgE and blood lead level children [18, 19]. Our study showed high significant levels in serum copper, lead and IgE in BA, which might suggest there is a correlation between serum levels of lead and copper with IgE level and allergic disorders such as asthma [20].

Furthermore, in our study we showed that serum IgA level was significantly increased in BA patients (p=0.012), however we could not find any hypo-IgA in both groups. It seems likely that IgA blood level increased following recurrent upper respiratory infection in these patients.

Although the increase of serum total IgE level could be due to ases of allergic base of asthma (expression of TH2 cytokines such as IL4) but also caused by relation to increase in serum lead and copper levels through the directed and undirected stimulation of B cells on the binding [21].

In conclusion, the increase of blood lead and copper levels in BA patients seems to have an important role in induction of asthma but it is seems that serum level of zinc was not difference in asthmatic compared healthy people.

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Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

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