



Trabajo Original

Serum trace element of children with and without bronchopneumonia *Niveles de oligoelementos en el suero de niños con bronconeumonía y sin ella*

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Abstract

Objectives: Trace elements like Zinc (Zn), iron (Fe) and copper (Cu) have a significant influence in maintaining the normal metabolic, modulating immune function and influencing the susceptibility of the organism to infection. But the relationship between trace element and bronchopneumonia was unclear.

Methods: In this study, 28 children with bronchopneumonia and 46 healthy age-matched children were recruited. Serum (Zn), Cu, Fe, calcium (Ca) and/or magnesium (Mg) levels in children with and without bronchopneumonia were determined by atomic absorption spectrophotometry.

Results: The results show that several microelement levels such as Zn, Ca, Mg, and Fe in bronchopneumonia group are lower than in control group. In bronchopneumonia group, serum Ca level is positively associated with zinc (Zn) ($p < 0.05$) and iron (Fe) ($p < 0.05$), while there is a pronounced positive correlation between copper (Cu) and calcium (Ca) ($p < 0.05$), magnesium (Mg) ($p < 0.05$).

Conclusion: Serum trace element level may be associated with risk of bronchopneumonia among children.

Key words:

Trace element.
Bronchopneumonia.
Children.

Resumen

Objetivos: oligoelementos como zinc (Zn), hierro (Fe) y cobre (Cu) tienen una influencia significativa en el mantenimiento de la función inmune y del metabolismo normales; modulan la función inmune e influyen en la susceptibilidad del organismo ante infecciones. Pero la relación entre trazas de estos elementos y la bronconeumonía resultó incierta.

Métodos: en este estudio fueron incluidos 28 niños con bronconeumonía y 46 niños sanos agrupados por edad. Se determinaron los niveles de Zn, Cu, Fe, calcio (Ca) y/o magnesio (Mg) en el suero de los niños con bronconeumonía y sin ella mediante espectrofotometría de absorción atómica.

Resultados: los resultados muestran que varios niveles de microelementos como Zn, Ca, Mg y Fe en el grupo con bronconeumonía son menores que en el grupo control. En el grupo de niños con bronconeumonía el nivel de Ca en el suero está asociado positivamente con el zinc (Zn) ($p < 0,05$) y el hierro (Fe) ($p < 0,05$), mientras que hay una correlación positiva entre el cobre (Cu) y el calcio (Ca) ($p < 0,05$), magnesio (mg) ($p < 0,05$).

Conclusión: el nivel de oligoelemento en el suero puede estar asociado con el riesgo de bronconeumonía entre los niños.

Palabras clave:

Elemento de rastro.
Bronconeumonía.
Niños.

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INTRODUCTION

Micronutrients, like Zn, Cu and Fe, are vitamins and minerals that are essential to growth and for the development of human beings. They also play an important role in immunity regulation. Several trace elements have been revealed to regulate immune responses, particularly cell-mediated immunity (1).

Previous studies revealed that Zn deficiency places children in many low- and middle-income countries at increased risk of illness and death from several infectious diseases possibly by reducing natural killer cell function and impair T-lymphocytes function (1,2) such as pneumonia, diarrhea and malaria (3-5). It reduces linear growth as well, whereas supplemental zinc may enhance their activity (6).

Deficiencies of zinc and iron may have serious consequences, with prodigious risk of delayed development, growth faltering, and increased infectious-disease morbidity during infancy and childhood (7,8). The available data for zinc supplement are promising with regard to the prevention of diarrhea and pneumonia (9,10). Trace elements are necessary for the proper functioning of the immune system, and for this reason, they might have a significant influence on the interaction between bacteria and host (6). Cu is an important trace element in humans, as it plays an essential role as a cofactor for numerous enzymes and other proteins which are crucial for metabolism, cell growth, iron transport, respiration, and hemostasis (11). Maybe the reduced production of interleukin-2 as well as the decrease of T cells proliferation is the mechanism in copper deficiency as a consequence of affecting the activity and effectiveness of cellular and humoral immunity (12).

Deficiency of these elements generally brings about illness or even death in the general population. The onset of pneumonia is associated with the immune function, genetic factors and nutritional status. However, the correlation between the levels of trace elements and pneumonia remains unclear. This study is to evaluate serum trace element of children with and without bronchopneumonia.

SUBJECTS AND METHODS

SUBJECTS

The present study was performed at a public hospital in Wuhu city. We reviewed the medical records of patients aged 3 to 6 year old who were diagnosed with bronchopneumonia. The criteria for review included all children patients who were admitted to the medical wards, diagnosed with bronchopneumonia with a proven or suspected gram-negative infection, normal renal function, and treated with gentamicin for at least 72 h. A total of 46 children aged-matched for routine health screening served as control group. This study was approved by the ethics committee of Mannan Medical College, and written informed consent was obtained from each subject.

COLLECTION OF BLOOD SAMPLES AND ANALYSIS OF BLOOD TRACE ELEMENT

Trained pediatric nurses collected blood specimens. Approximately 0.5 mL of venous blood was collected for blood trace element analysis. Then, atomic absorption spectrophotometry (BH model 5.100 manufactured by Beijing Bohu Innovative Electronic Technology Corporation) was used to determine serum level of trace element (Cu, Pb, Fe, Ca, Mg and Zn).

STATISTICAL ANALYSIS

Statistical analyses including the mean and standard deviation values of all results were performed using R software programming language (13). Student's unpaired t-test was used to analyze the differences for serum trace element between the control group and the pneumonia group. Pearson's partial correlation coefficient was used to determine an association among serum trace element. All statistical tests were two-sided, and value of $p < 0.05$ was considered as statistically significant.

RESULTS

GENERAL CHARACTERISTICS

The general characteristics of several micronutrients in the bronchopneumonia group and the health control group are showed in table I. No significant differences were found in Cu and Pb between the two groups. However, bronchopneumonia group had significantly lower serum Fe ($p < 0.001$), Ca ($p < 0.001$), Mg ($p < 0.001$) and Zn ($p < 0.001$) levels compared to the control group.

CORRELATION AMONG SERUM TRACE ELEMENT LEVELS IN CONTROL GROUP

We explored the correlation of serum trace element levels in both groups. The correlation coefficient and correction trend in

Table I. Comparison of serum trace element levels present in both groups

Parameter	Control (n = 46)		Pneumonia (n = 28)		p
	Mean	SD	Mean	SD	
Pb ($\mu\text{g/l}$)	63.54	13.0	62.36	10.94	0.122
Cu ($\mu\text{g/dl}$)	1.65	0.08	1.64	0.08	0.585
Zn ($\mu\text{mol/l}$)	66.35	11.17	62.94	10.43	0.000
Ca (mmol/l)	24.37	3.10	23.24	3.08	0.000
Mg (mg/dl)	151.00	14.40	121.00	13.60	0.000
Fe ($\mu\text{g/dl}$)	87.89	11.45	75.16	8.53	0.000

the control group are depicted in Table II. It shows that serum Cu level is positive associated with Ca and Mg ($p < 0.05$) in control group, but correlation between calcium (Ca) and iron (Fe) shows a slight inverse trend.

CORRELATION OF SERUM TRACE ELEMENT LEVEL IN BRONCHOPNEUMONIA GROUP

Table III shows that serum Ca is associated with Zn and Fe ($p < 0.05$) in the bronchopneumonia group, but a weak inverse correlation is found between serum Mg and Fe.

No significant difference regarding serum Mg level was found between children with and without bronchopneumonia (Fig. 1).

Table II. Correlation of serum trace element level in control group

	Pb	Cu	Zn	Ca	Mg
Cu	- 0.03
Zn	0.21	0.12	.	.	.
Ca	- 0.05	0.44*	0.11	.	.
Mg	0.16	0.32*	0.25	- 0.02	.
Fe	0.00	0.01	- 0.07	- 0.14	0.27

* $p < 0.05$.

Table III. Correlation of serum trace element level in bronchopneumonia group

	Pb	Cu	Zn	Ca	Mg
Cu	0.27				
Zn	0.1	0.32			
Ca	0.28	0.18	0.46*		
Mg	0.22	0.26	0.27	- 0.02	
Fe	0.25	0.04	0.21	0.46*	- 0.14

* $p < 0.05$.

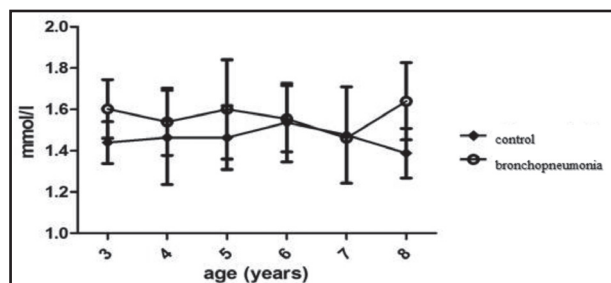


Figure 1.

Comparison of serum Mg levels by age in both groups.

DISCUSSION

The present study compared several serum micronutrient levels of Zn, Ca, Mg, Fe, Cu and Pb in children with or without bronchopneumonia. The major finding was that serum Fe, Ca, Mg and Zn levels were lower in pneumonia group compared to the health controlled group of children. Also, the outcome has statistical significance ($p < 0.01$), while there is no statistical significance in the levels of Cu and Pb between the two groups. Furthermore, a positive correlation of Ca with Zn and Fe in bronchopneumonia group and a positive correlation of Cu with Ca and Mg were found in the group of health children.

Carpentieri et al. (14) reported even in presence of optimal concentrations of Fe, Cu, and Zn. Fe and Cu revealed synergistic stimulatory effects at low concentrations and synergistic inhibitory effects at high concentrations. Or rather the inhibitory effect of Cu at concentrations is lower than those of Fe and Zn. Schamschula et al. (15) reported that consistent interdependence patterns between elements indicate the operation of a mineral level regulating mechanism, effective under diverse environmental conditions. Chen et al. (16) reported that there is a positive correlation of lead with zinc, iron and magnesium, and a negative correlation of lead with calcium was found in the group of children with blood Pb level. Basavaraj et al. (17) reported that there is a disturbance in the under-study element contents and also element-element interdependency in psoriasis serum when compared to controls.

Sobol et al. (18) reported that sick infants during pneumonia acute stage present higher copper and ceruloplasmin concentration values in relation to the control group. Pizent et al. (19) reported that chronic moderate exposure to lead decreased serum zinc, calcium and, to a lesser extent, copper levels, all changes in serum concentrations of these essential elements were significant but remained within the normal range.

This study has several limitations, for example, the size of study subjects in both the pneumonia and healthy control groups was not large enough to have statistical power for the results of several serum biomarkers. Moreover, our study is based on data of routine health screening, lack of the microelements intake records, because microelements absorption depends on intakes and physiological status of individuals.

Some researchs provide an impetus to evaluate the potential benefits of supplementation programs for individuals and groups with suboptimal trace element status as a cost-effective means of reducing the risk of infectious diseases (6). Preventive and therapeutic interventions should be implemented as they could improve the efficacy of pneumonia treatments in pediatric patients and shorten hospital stay in developing countries where microelements deficiency is likely to be prevalent (4,20).

Overall, these data suggest that Zn, Ca, Mg, and Fe may reflect the inflammation to children subjects with bronchopneumonia. Further investigation is necessary to identify the role of serum trace element levels in populations at different physiological status.

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