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ORIGINAL ARTICLE

Blood zinc levels in children hospitalized with pneumonia: A cross sectional study

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Abstract *Background:* Recent works have provided conflicting evidence on the role of zinc in acute lower respiratory infection (ALRI).

Objective: We aimed to study the relation between blood zinc levels and severity of pneumonia.

Patients and methods: A retrospective study was conducted in the Cairo University Pediatric Hospital, to assess serum zinc levels in 40 Egyptian children, aged 3–144 months, admitted with the diagnosis of pneumonia. Half of them were admitted in the general ward and the other half were admitted in the pediatric ICU.

Results: Males (67.5%) were more affected by ALRI than females. The mean serum zinc in patients was normal (80.33 + 25.3 µg/dL) yet, the mean serum zinc level in PICU patients was lower than that of general ward patients ($p = 0.001$).

Conclusion: We concluded that the lower the serum zinc level, the higher the grade of respiratory distress among children with pneumonia.

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Introduction

Acute lower respiratory infections (ALRI) predominantly pneumonia is a substantial cause of mortality and morbidity in children less than 5 years of age. In developing countries an estimated 146–159 million new episodes of pneumonia are observed per year [1].

Patients with pneumonia have been found to have lower blood zinc levels as compared to uninfected children [2]. Trials of zinc in children with severe pneumonia have shown that adjuvant treatment with 20 mg zinc per day accelerates the recovery from severe pneumonia in children [3].

Zinc is an important trace element in the body that can be found in meat, shellfish, cheese, legumes and whole grains. Zinc has a fundamental role in cellular metabolism, with profound effects on the immune system and the intestinal mucosa [4,5].

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Zinc deficiency is common in children from developing countries due to high incidence of malnutrition, lack of intake of animal foods, high dietary phytate contents and inadequate food intake with increased fecal loss during diarrhea [6].

We aimed to assess the blood zinc status in children suffering from pneumonia and to evaluate the relationship of zinc status to its severity.

Subject and methods

Study design and settings

This was a case–control study conducted in the El Monira Children Hospital, Cairo University, over a period from October 2012 to April 2013. The enrolled children were between the ages of 3–144 months. Half of the cases were recruited from Pediatric Intensive Care Unit (PICU) and the other half from general pediatric ward, all satisfying the World Health Organization (WHO) case definition of severe pneumonia [7].

Appropriate consent from every mother and ethical approval from the ethics committee were taken. Excluded were the children less than 3 months or more than 144 months with associated clinical diagnosis of diarrhea, allergic diseases or asthma. Children with known zinc supplementation prior to admission for the current illness were also excluded.

Variables for data collection

Data were collected on age, sex, anthropometry, family characteristics, environmental exposures and immunization status. Patients were examined clinically. Clinical features of zinc deficiency like skin lesions (Perioral erosive dermatitis, Erosive dermatitis affecting the diaper area, and Erosion and scald-like erythema on the acral parts) or poor wound healing were documented. Data on investigations ordered by the treating physician (including Arterial blood gases (ABG) and Zinc estimation) were abstracted. Record of the treatment given and outcome of the disease were also maintained.

Zinc estimation

For this 2 mL of whole blood was collected using 22 gauge steel needle which was added to a dry tube, allowed to be clotted for 30 min, and then separated by centrifugation at 4000 rpm for 5 min. It was sent to the Chemical pathology central Laboratory, Faculty of medicine, Cairo University for analysis. Serum zinc was determined using Atomic absorption spectrometer (AAS) (PerkinElmer AAS 800®*). Samples were diluted to 1:4 with distilled water (DW). The level of serum zinc was calculated after application of absorbencies on suitable calibration curve for each element made from standard solutions [8].

Statistical analysis

Analysis of data was done using SPSS (statistical program for social science version 15), quantitative variables were expressed as mean, SD and range, qualitative variables as frequency and percentage, unpaired t-test was used to compare two groups as regards quantitative variable in parametric data, Mann Whitney Willcoxon test was used to compare two groups as regards the non parametric data. P value < 0.05 was considered as statistically significant.

3. Result

The current study recruited 40 Egyptian children [27 males (67.5%) and 13 females (32.5%)] hospitalized with acute lower respiratory tract infections (ALRI) of different severity. Twenty cases were from PICU and 20 cases from the general ward.

Table 1 shows that mean serum zinc level in our patients was normal.

In the current study, females had higher mean zinc levels than males, however this higher level was not statistically significant ($p = 0.86$) as shown in Table 2.

We further classified our cases according to the grade of respiratory distress (RD), and it was found that 30% presented with RD I (tachypnea), (13 cases) 32.5% presented with RD II (tachypnea and retractions), 12.5% presented with RD III (tachypnea, retractions and grunting) and 25% presented with RD IV (tachypnea, retractions, grunting and cyanosis). Regarding the zinc levels among patients with different grades of respiratory distress, our study revealed that higher values of zinc were recorded with the lower grades of respiratory distress, and that these higher values were statistically significant between groups ($p = 0.000$) as demonstrated in Table 3.

All patients with RD I and II; 2 cases with RD III and 2 cases with RD IV were discharged while the rest of the cases with RD III and IV died (Table 4).

In the current study the mortality rate was 27.5%. We found that the mean serum zinc levels were significantly higher in patients who were discharged than those who died 91.79 ± 19.76 and 51.73 ± 11.79; respectively ($p = 0.006$) and this correlates serum Zinc levels to fate.

All patients with RD IV and 4 cases with RD III needed mechanical ventilation while the rest of the cases with RD I and RD II needed only nasal pronge, all children on nasal

Table 1 Characteristics of studied cases.

	Mean ± SD*
Age (months)	24 ± 15
Weight (kg)	9.39 ± 4.52
Serum zinc level (µg/dl)	80.77 ± 25.38

* SD: standard deviation.

Table 2 Zinc levels among patients according to gender.

	Male ($n = 27$)	Female ($n = 13$)	P value
Blood zinc levels (µg/dL)	80.30 ± 27.76	81.77 ± 20.55	0.86

Table 3 Zinc levels among patients with different grade of respiratory distress.

Grades of RD[*]	Zinc (μg/dL) Mean ± SD[**]	P value
RD I	101.83 ± 14.45	0.00
RD II	86.77 ± 20.80	
RD III	70.80 ± 18.08	
RD IV	52.70 ± 15.48	

[*] RD: respiratory distress.
[**] SD: standard deviation.

Table 4 Relation between grades of respiratory distress and fate.

	Fate	
	Discharged (n = 29)	Died (n = 11)
RD I (n) (%)	12 (41.4)	
RD II (n) (%)	13 (44.8)	
RD III (n) (%)	2 (6.9)	3 (27.3)
RD IV (n) (%)	2 (6.9)	8 (72.7)

RD: respiratory distress.

Table 5 Relation between respiratory support and fate.

	Fate	
	Discharged (n = 29)	Died (n = 11)
Nasal pronge (n, %)	26 (100%)	0 (0%)
Mechanical ventilation (n, %)	3 (21.4%)	11 (78.6)

oxygen supply were discharged, while 78.6% of mechanically ventilated died (Table 5).

Concerning serum zinc levels in patients who needed only nasal pronge as compared to mechanically ventilated ones, it was found that it was statistically higher in former than latter 92.81 ± 19.83 and 58.43 ± 18.68 respectively ($p = 0.001$), revealing the association between lower zinc levels and the need for a more advanced respiratory support.

Discussion

In this study it was found that the mean age of our patients was 24 ± 15 months. This result was higher than that found in studies undertaken by Valentiner-Branth et al. (2010) [9], Basnet et al. (2012) [10] and Srinivasan et al. (2012) [11] and lower than that reported by Shah et al. (2012) [12]. This difference in mean age found may be due to the wide variation in the causative organisms that led to pneumonia.

In our study the mean weight of studied patients was 9.39 ± 4.52 kg. This was in agreement with results observed by Ugwuja et al. (2007) [13]; and Shah et al. (2012) [12].

We observed that male patients were affected by pneumonia more than females, which delineate our cultural preference and concern regarding male gender. This male predominance was also recorded by other studies [9,10,14].

In our study, females had higher zinc levels than males, without known explanation. This was in agreement with other researches [3,15].

Unexpectedly, the mean serum zinc levels in our patients were normal. This was in agreement with results observed by Bitarakwate et al. (2003) [16] and Srinivasan et al. (2012) [11]. This may be explained by longer period of breast feeding in our country and the known fact that high concentration of zinc is in colostrum (Arıca et al., 2011) [17].

There was a negative correlation between low serum zinc level and the susceptibility to infections mainly respiratory infections and the grade of respiratory distress. This was similar to results found by Shakur et al. (2004) [4] and Kumar et al. (2004) [6]. On the other hand, two other studies concluded that serum zinc levels were not significantly different in children having ALRI from those serum levels of healthy controls [18,19].

We demonstrated that the higher the serum zinc levels, the lesser the respiratory support needed ($p = 0.001$). This may be attributed to the role of zinc in reducing inflammation of lower respiratory tract resulting in the improvement of respiration [20].

Our study revealed that, patients who recovered and were discharged had a higher plasma zinc level than those who died. This result was in agreement with studies under taken in Bangladesh [3] and in Nepal [10]. These results were in contradictory with a study done by Anuradha et al. (2006) in Vellore [21].

Conclusion

Although the mean serum zinc level in our patients was normal, the mean serum zinc level in PICU patients (RD III and RD IV) was lower than that of general ward patients (RDI and RD II). So, we concluded that lower serum zinc levels were related to more critical cases.

The lower serum zinc levels were associated with more advanced respiratory support. Death was more prevalent among patients with low serum zinc level.

Recommendations

We recommend the use of hair zinc levels as a more accurate estimation of the body zinc content, because hair zinc is relatively stable and does not fluctuate easily.

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