Using Zinc Sulphate to Improve Symptoms of Severe Pneumonia in Children Under 5 Years of Age: A Case Control Study

Tulika¹, Gopal Sharan²

¹Senior Resident, Department of Pediatrics, Patna Medical College and Hospital, Patna, Bihar, India

²Professor, Department of Pediatrics, Patna Medical College and Hospital, Patna,Bihar, India

Abstract

Background: According to World Health Organization (WHO), Pneumonia is a form of acute respiratory infection that affects the lungs. Pneumonia is considered as the most important infection-induced cause of child mortality.

Aim: To investigate the effect of prescribing zinc sulphate on improving the clinical symptoms of Severe pneumonia in 2-59 months old children.

Materials and Methods: This case control study was performed on 120 children with age of 2-59 months and complaining of fever, coughs, and tachypnea. The patients were randomly assigned into control (n=60), and intervention (n=60) using double blinding method. In the control group placebo was prescribed, while the intervention group received oral zinc sulphate 20 mg on day of admission and then 10 mg BD for 7 days. During hospitalization, every 12 hours the clinical symptoms of both groups including tachypnea, duration of fever, coughs, intercostal retraction, hypoxia, crackles-wheezing, and duration of hospitalization were recorded. At the beginning and end of the treatment, two blood samples were taken for determining the serum level of zinc.

Results: The findings indicated that the serum level of zinc sulphate after the intervention increased significantly in the intervention group. There was a significant difference in the duration of fever and tachypnea between the intervention and control groups 36 hours post-hospitalization.

Conclusion: Supplemental administration of zinc can expedite the healing process and results in faster resolution of clinical symptoms in children with pneumonia.

Keywords: Zinc, Pneumonia, Tachypnea.

Introduction

Acute lower respiratory tract infection is one of the most important and common diseases among children, which is accompanied by high mortality rate, especially in young children [1]. Pneumonia is one of the most common implications of lower respiratory tract involvement.

Pneumonia is a form of acute respiratory infection that affects the lungs. When an individual has pneumonia, the alveoli are filled with pus and fluid, which makes

breathing painful and limits oxygen intake. Pneumonia is the single largest infectious cause of death in children worldwide. Pneumonia killed 808,694 children under the age of 5 in 2017, accounting for 15% of all deaths of children fewer than five years old [2]. According to WHO, annually 4.1 million deaths occur worldwide due to acute respiratory infections (ARIs), with 90% being due to acute pneumonia. Specifically, 1.9 million of them are children younger than five years old [3], mostly related to developing countries because of malnutrition [4].

Pneumonia is caused by a number of infectious agents, including viruses, bacteria and fungi. The most common are *Streptococcus pneumonia, Haemophilus influenzae* type B. In infants infected with HIV, *Pneumocystis jiroveci* is one of the most common causes of pneumonia, responsible for at least one quarter of all pneumonia deaths in HIV-infected infants.

In children under 5 years of age, who have cough and/or difficult breathing, with or without fever, pneumonia is diagnosed by the presence of either fast breathing or lower chest wall in drawing where their chest moves in or retracts during inhalation (in a healthy person, the chest expands during inhalation) [2]. According to WHO, clinically, pneumonia involves acute cough attacks with or without fever associated with respiratory problems or tachypnea [5].

Zinc is an essential trace element required for maintaining intestinal cells, bone growth, and immune function. Children who are living in low-income settings are often undernourished and zinc deficient [6]. Deficiencies may arise from the insufficient intake of foods containing zinc or insufficient absorption. Most foods high in zinc are of animal origin, such as meats, fish and dairy products. These foods may be more difficult to access for low-income populations. Zinc deficient children are at increased risk of restricted growth and developing diarrheal diseases, as well as respiratory tract infections such as acute

lower respiratory tract infections [7, 8]. Under-nutrition is considered the underlying cause of approximately half of these fatal acute lower respiratory tract infections [8].

Materials and Methods:

This case control study was performed on 120 children with age of 2-59 months and complaining of fever, coughs, and tachypnea presented to the department of Pediatrics, Patna Medical College and Hospital, Patna, Bihar, India.

Inclusion criteria

Children between 2 months to 5 years of age admitted to the pediatric wards were assessed and considered eligible for enrollment in the trial if they fulfilled the criteria for a diagnosis of severe pneumonia. Severe pneumonia was defined as per WHO/IMCI (Integrated Management of Childhood illness) guideline [9] and whose parents provided written informed consent were included in the study.

Exclusion criteria

Patients who had congenital cardiac or renal disease, severe malnutrition (as defined by WHO), concomitant diarrhea, severe anemia (Hemoglobin <8 g/dl), complicated pneumonia, congenital lung anomalies, chronic cough, documented tuberculosis, recurrent wheezing and children who were receiving zinc supplements were excluded from the study.

Methodology

The patients were randomly assigned into control (n=60), and cases (n=60). The control group received placebo (similar to the zinc sulfate syrup in terms of color and taste). The case group received oral zinc sulphate 20 mg on day of admission and then 10 mg BD for 7 days. During hospitalization, every 12 hours the clinical symptoms of both groups including tachypnea, duration of fever, coughs, hypoxia, wheezing and duration of hospitalization were recorded. At the

beginning and end of the treatment, two blood samples were taken for determining the serum level of zinc. The rest of the standard and conventional treatments of pneumonia were performed according to the protocol and daily routine.

The detailed demographic information, history, clinical findings and details of clinical course of cases and controls included in the study were entered in predesigned and validated proforma. Detailed General examination was carried out in the patients along with Respiratory system and other systemic examination and a clinical diagnosis was made and entered into the proforma. The details of blood investigations and imaging for confirmation of clinical diagnosis were also noted during the stay of the patient in the

hospital. The serum zinc estimation was done by using colorimetric test.

The data obtained from the cases and controls was compiled and analysed.

Results

60 patients were assigned to the control group and other 60 to the case group. 41(68.33%) of cases being male and 19(31.67%) being female in the case group as compared to 38(63.33%) of controls being male and 22(36.67%) being female. There was no significant difference between the two groups in terms of age and gender. The mean age of the hospitalized patients was 12.27±0.883 months in the case group and in the control, it was 14.17±0.924 months.

Table 1: Demographic profile of the children

Parameter	Cases	Controls
Sex		
Male	41 (68.33%)	38 (63.33%)
Female	19 (31.67%)	22 (36.67%)
Age		
Mean age of Hospitalized Patients	12.27±0.883	14.17±0.924

Table 2: Comparison of zinc levels in cases and controls

Group	Zinc level during Admission (Mean values ± Std deviation)	Zinc levels during Discharge (Mean values± std deviation)
Case	54.92±12.43	89.04±13.15
Control	56.27±11.98	58.11±12.29

Table 3: Comparison of patients with complain of tachypnea in cases and controls

Group	Tachypnea during Admission [No. of cases (%)]	Tachypnea after 48 hours of admission [No. of cases (%)]
Case	43 (71.67%)	7 (11.67%)
Control	47 (78.33%)	12 (20.00%)

The normal range of serum zinc levels is in the range of 60-150 ug/dl. The mean value of serum zinc levels for the cases was 54.92 ug/dl compared to 56.327 ug/dl for the control group during admission. During discharge, mean value for the case group was raised upto 89.04 ug/dl while it was

approximately same (58.11 ug/dl) for the control group.

During admission, 43 (71.67%) and 47 (78.33%) patients from case and control groups respectively had complain of tachypnea but after 48 hours of admission, 7 (11.67%) and 12 (20.00%) patients had complained of tachypnea. According to

Chi-square and Fisher exact test, there was no significant difference between the two groups regarding presence or absence of wheezing during hospitalization and hours post-hospitalization.

Discussion

In this research, compared to the comparison group, a significant decrease was found in the duration of hospitalization and recovery from pneumonia symptoms in zinc-receiving children. This indicates the effect of zinc therapy and a change in the clinical course of pneumonia among the children under investigation. This finding is consistent with the results of most studies in this field [11, 12], In another similar study in India that was conducted on 153 children aged 2–24 months, who were hospitalized due to acute lower respiratory infection and divided into two groups (one taking 10 mg of zinc plus vitamin A daily, and the other taking placebo plus vitamin A), it was shown that the recovery time was significantly faster in the treatment group than in the control group. Overall, zinc therapy can reduce the duration of symptoms and acute clinical condition [12].

Zinc supplementation in children causes an increase in the levels of complement in the blood that modulate the function of monocytes, macrophages and neutrophils polymorphs. It also helps in the development and activation of T-lymphocytes. When zinc supplements are given to individuals with low levels of zinc, the numbers of T-cell lymphocytes circulating in the blood increase and the ability of lymphocytes to fight against infection improves [13].

However, evidence to the contrary was found in studies by Bose et al. and Valentiner - Branth et al [14, 15]. Argument has been put by the above studies that as zinc is required to mount a better immune response by the host against infection, there will be increased damage to the respiratory epithelium due to the increased immune response and thus leading to worsening of symptoms [15].

A number of authors have confirmed that routine zinc supplementation for more than three months does have a positive effect on reducing the duration of acute lower respiratory tract infections among children in developing countries [16, 17].

Conclusion:

According to the results of the present study and comparing them with other similar studies in this field, it can be concluded that zinc sulphate can hasten the recovery from pneumonia and quickly resolve its symptoms in children suffering from this disease. These effects can do major absolute reductions in childhood morbidity and mortality rates in the numbers of children who die from acute lower respiratory tract infections every year. It remains important to better understand how zinc therapy can also reduce the drug resistance caused by multiple antibiotic therapies.

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