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ASSESSMENT OF ZINC SUPPLEMENTATION AS AN EFFICACIOUS THERAPY ON CHILDREN PRESENT PNEUMONIA

Paediatric Medicine

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ABSTRACT

In the present study, we attempted to know the efficacious role of zinc supplementation among children (<2 years of age) who present pneumonia. The study was conducted at Prathima Institute of Medical Sciences, Nagnoor, Karimnagar, from November 2019 to October 2021. The data were collected through history and clinical examination, and the zinc was estimated as per standard protocol. In this study, the population predominantly had crepts 90.4%, Of these 7 (4 in group A and 3 in group B) belonged to severe pneumonia. About 78.0% belonged to the severe pneumonia group and 22% belonged to the non- severe pneumonia group. The zinc efficacy in this study may be because most of our children belong to severe pneumonia. The mean time for the disappearance of danger signs was 43.3 hrs. in group A and 62.8 hrs. in group B without significant change (p=0.246). The average time taken to reach oxygen saturation of more than 90% percent was less in group A. The mean time was 23.9 hrs. in group A and in group B it was 45.8 hrs. without significant change (p=0.130). The mean time for resolution of distress is 52.48 hrs. in group A when compared with 74.47 hrs. in group B in which the comparison observed significant change (p=0.05). The mean time required for group A to become asymptomatic was 65.52 hrs. and 88.00 hrs. in group B with a significant difference (p= 0.05). The duration of hospital stay was less in group A when compared with group B. It took about 6.14 days in group A and 7.14 days for group B, the comparison was non-significant (p= 0.368). In conclusion, zinc supplements are efficacious among the children presenting pneumonia.

KEYWORDS

Children <2 years, Disease Disappearance, Pneumonia, Zinc Supplement

INTRODUCTION

Worldwide pneumonia is leading cause of paediatric morbidity and mortality.[1] WHO (World Health Organization) has estimated that each year pneumonia kills up to 2.4 million children, which accounts for 19% of all deaths in the under-five age group.[2] The incidence of pneumonia is >10-folds higher and the number of childhood-related mortality due to pneumonia approximately 2000-folds higher in developing countries than in developed countries.[3] About 95% of the pneumonia related mortalities occur in developing countries and the younger age group have the highest risk of death.[4] India contributes nearly 20%.[5]

There are certain socio-economic and environmental factors that are responsible for pneumonia. Socioeconomic status, severe malnutrition and lack of breast feeding particularly in early months of life contribute to development of pneumonia.[6,7] Elimination of most of the environmental risk factors of pneumonia is very difficult, but some nutritional factors need a simple intervention.[8] Malnutrition is estimated to contribute up to half of mortality by pneumonia. While much emphasis is placed on protein energy malnutrition (PEM) and vitamin A, it has been proposed that zinc can be a real potential in the prevention of pneumonia morbidity and mortality.[9]

The deficiency of zinc is common among children from developing countries due to insufficient food consumption, especially from animal resources, which revealed limited zinc availability from these regional diets. Zinc deficiency impairs the immune system and increases the rate of serious infections such as pneumonia.[8,10]

Zinc is reported to prevent pneumonia and also prevent diarrhea.[7] It might act in the acute phase response to infection, helping to boost the body. The immune response through a defense cascade, commencement with mobilization and sequestration of zinc to metallothiennin-rich tissue, faster regulation of immune defense specific protein synthesis, activation of immune defense activity such as lymphocytes, macrophages and normal killer cells and antibody supported cytotoxicity.[7] Children pose with adequate zinc status may have a higher strong immune response compared to poor zinc status.

Zinc given together with antimicrobial therapy to young children with pneumonia was associated with a significant reduction in the duration of pneumonia.[11] According to a report from WHO, zinc supplements are the most effective among all nutritional supplements available for preventing pneumonia. Trials assessing zinc effectiveness in children with mild to moderate zinc deficiency have demonstrated that zinc supplementation significantly prevents pneumonia and enhances outcomes during severe disease episodes. Recommended zinc nutritional intake is 10-20 mg per day for children. Normal zinc levels are estimated of about 65-150µg.[12]

In the present study, we attempted to know the efficacious role of zinc supplementation among children (less than 2 years of age) who present pneumonia.

MATERIALS AND METHODS

Study Design

All children admitted in the age group of less than 2 years with features of pneumonia as per IMNCI guidelines at Prathima Institute of Medical Sciences, Nagnoor, Karimnagar, from November 2019 to October 2021. The data were collected through history and clinical examination, and the zinc was estimated as per standard protocol.

Inclusion Criteria

All children of age groups less than 2 years fulfilling IMNCI guidelines for pneumonia. For children in the age group of 2 months to 12 months respiratory rate of more than 50 is considered tachypnea. And for children 12 months to 24 months respiratory rate of more than 40 is taken as tachypnea.

Exclusion Criteria

Other than Community Acquired Pneumonia, which has the risk factors for recurrent and persistent pneumonia like Congenital Heart Disease, Development delay, Congenital lung deformities, etc.

Study Procedure

All children in the age group of less than 2 years who presented with features of pneumonia defined by IMNCI to our Prathima Institute of Medical Sciences were approached. About 44 children were selected and 2 (1 CHD in each group) were excluded as per exclusion criteria defined. They were grouped into two groups by Stratified Randomization. Each group was allotted 21 children. One was kept as Group A (standard treatment with zinc supplement) and another as Group B (only standard treatment).

At admission we calculated respiratory rate for one minute and chest indrawing was observed. The oxygen saturation (by pulse oximetry), auscultation findings (crepts, wheeze, bronchial breath sounds) and danger signs (cyanosis, inability to feed, lethargy, unconsciousness, convulsions, stridor) were recorded.

Enrolled children were given standard treatment for pneumonia in the form of oxygen if the saturation less than 90, intravenous fluids, bronchodilators and parenteral antibiotics. Intravenous fluids were removed once respiratory distress had settled and the child accepting orally. Group A received 20 mg of elemental zinc per day as a single dose for seven days.

Observations are made in terms of time for disappearance of danger signs, time taken to reach saturation more than 90% in room air, time for resolution of distress defined by resolution of tachypnea and retractions, time to became asymptomatic defined by resolution of distress and disappearance of danger signs and SpO2 > 90 in room air, finally duration of stay in each group.

The zinc was estimated by using 2 ml of blood was collected from all the 42 children in plain container on day one of admission. It was then centrifuged, and zinc estimation was made by colorimetric method. Reference range of normal zinc level was set as 65-150 microgram/dL.

Statistical Analysis

Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups. Leven's test for homogeneity of variance has been performed to assess the homogeneity of variance Chi-square/Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

RESULTS

Table 1 describes the comparative analysis of baseline features between the groups among studied children. The age group, gender and locality were not observed significant changes between the groups.

Table 1: Demographic Profiles Between Groups of Studied Children

Demographic profiles	Group A (n = 21)	Group B (n = 21)	P value	Sig.
Age group (months, M ± SD)	15.33 ± 5.98	13.57 ± 7.05	0.388	NS
Gender (n, %) Male Female	 14 (66.7) 7 (33.0)	 14 (66.7) 7 (33.0)	1.000	NS
Locality (n, %) Rural Urban	 5 (23.8) 16 (76.1)	 6 (28.5) 15 (71.4)	0.726	NS

Table 2 evaluates the comparative analysis of clinical features between the groups among studied children. The chief complaints, Chest findings, O2 at RA, diagnosis and zinc level were not observed significant change between the groups.

Table 2: Clinical Features Between Groups of Studied Children

Clinical features	Group A (n = 21)	Group B (n = 21)	P value	Sig.
Chief complaints				
Cough (n, %)	21 (100.0)	21 (100.0)	1.000	NS
Fever (n, %)	21 (100.0)	19 (90.4)	0.147	NS
Hurried breathing (n, %)	21 (100.0)	20 (95.2%)	0.311	NS
Cold (n, %)	2 (9.5)	5 (23.8)	0.214	NS
Chest findings Crepts (n, %) Wheeze (n, %) BBS (n, %)	 19 (90.4) 11 (52.3) 2 (9.5)	 19 (90.4) 7 (33.3) 3 (14.2)	0.665	NS
O2 at RA <90 >90	 10 (47.6) 11 (52.3)	 13 (62.0) 8 (38.0)	0.352	NS
Diagnosis Pneumonia (n, %) Severe pneumonia (n, %)	 4 (19.0) 17 (81.0)	 5 (23.8) 16 (76.1)	0.707	NS
Zinc level (mg/dl) <65 65-150 >150	 6 (28.5) 14 (66.7) 1 (4.7)	 5 (23.8) 16 (76.2) 0 (0.0)	0.734	NS

Table 3 measures the outcomes of zinc supplementation between the groups among studied children. The mean value of time for disappearance of danger signs, time for resolution of distress and time to be asymptomatic were observed significant change while rest parameters were not observed significant change between the groups.

Table 3: Outcomes of Zinc Supplementation Between Groups of Studied Children

Parameters	Group A (n = 12)	Group B (n = 14)	P value	Sig.
Time for disappearance of danger signs (hrs. M ± SE)	43.33 ± 13.89	62.28 ± 10.73	<0.001	S
O2 at > 90 RA (hrs., M ± SD)	23.9 ± 38.36	45.8 ± 53.42	0.130	NS
Time for resolution of distress (hrs., M ± SD)	52.47 ± 33.99	74.47 ± 37.45	0.05	S
Time to be asymptomatic (hrs., M ± SD)	65.52 ± 35.03	88.00 ± 37.97	0.05	S
Duration of hospital stay (Days, M ± SD)	6.14 ± 3.55	7.14 ± 3.57	0.368	NS

DISCUSSION

The present study only included children who belong to the age group less than 2 years. This is similar to the age group undertaken by Brooks et al.[13], Bose et al.[14], and Bansal et al.[2] The mean age (in months) of distribution in this study is 15.3 and 13.5 whereas Ganguly et al.[15] reported 17 and 10 and Valavi et al.[8] obtained 15.4 and 15.3 in zinc and non-zinc supplement group. Recently, Farahat et al.[16] observed 12 months and 13 months of mean age in zinc-supplement and placebo group.

The gender distribution was nearly about 2:1 in favour of males. This is consistent with Bose et al. (2:1)[14] and Ganguly et al. (2:1) studies.[15]

In this study, there were the maximum percentages of urban children contributing about 76.4% and 71.4% among the study population. Gothankar et al.[17] reported maximum rural children compared to urban children of Maharashtra, India who presented childhood pneumonia.

Out of 11 patients, zinc deficient children were 7 cases from urban areas amounting 63.6% and rural children amounting 36.4%. In the recently conducted pilot study in five states by Kapil and Jain[18] pointed that prevalence of zinc deficiency in Karnataka was 36.2%. The difference can be because that study was conducted in rural and healthy population, unlike our study, which contained 73.4% of urban population and all are pneumonia children.

In this study population, predominantly had crepts 90.4%, which is consistent with Brooks et al.[13] (100% had crepts). Studies reported by Bose et al.[14] (93% wheeze) and Bansal et al.[2] (68% wheezy children), which showed no difference in outcome had predominantly wheezy children.

Zinc deficiency was found in about 11 children accounting for 26.1% of study population. Among these 6 were in group A and the remaining 5 were in group B. Of these 7 (4 in group A and 3 in group B) belonged to severe pneumonia.

In this study, about 78.0% belonged to the severe pneumonia group and 22% belonged to the non- severe pneumonia group. The zinc efficacy in this study may be because most of our children belong to severe pneumonia. This is consistent with many studies conducted by Valentiner-Branth et al.[19], Valavi et al.,[8] Brooks et al.[13] and Bansal et al.[2] All these studies concluded that zinc role as an adjuvant is significant in severe pneumonia.

The mean time for the disappearance of danger signs was 43.3 hrs. in group A and 62.8 hrs. in group B without significant change (p=0.246). This was similar to the study by Mahalanabis et al.[20] in which the data was significant (p=0.045) between the group of 60.75 hrs. and 69.75 hrs.

The average time taken to reach oxygen saturation of more than 90% percent was less in group A. The mean time was 23.9 hrs. in group A and in group B it was 45.8 hrs. without significant change (p=0.130), which is similar to the study of Brooks et al.[13] study (95% is taken as cut off) of 88 hrs. and 96 hrs. in zinc and placebo group, respectively.

The mean time for resolution of distress is 52.48 hrs. in group A when compared with 74.47 hrs. in group B in which the comparison observed significant change (p=0.05). This is similar observation by Valavi et al.[8] in which 32.87 hrs. and 37.37 hrs. (p=0.001), Brooks et al.[13] where 40 hrs. and 48 hrs. and Mahalanabis et al.[20] where 70.5 grs. and.79 hrs. (p=0.29) in zinc and non-zinc supplementation groups.

The mean time required for group A to become asymptomatic was 65.52 hrs. and 88.00 hrs. in group B with a significant difference (p= 0.05). This is similar to Brooks et al.[13] where 84 hrs. and 96 hrs., Valavi et al.[8] in which 42.26 hrs. and 47.52 hrs. and in Mahalanabis et al.[20] of 76 hrs. and 84 hrs. with the significant differences (p=0.001 and p=0.04).

The duration of hospital stay was less in group A when compared with group B. It took about 6.14 days in group A and 7.14 days for group B, the comparison was non-significant (p= 0.368). It was reported that about 4 days and 5 days by Brooks et al.[13] and 5 days and. 5.5 days (p=<0.001) as per the report of Valavi et al.[8]

CONCLUSION

The present study showed clinical reductions in the time required for recovery from symptoms of pneumonia. There were reductions in the average time required for disappearance of danger signs, mean time required to reach O_2 >90, mean time for resolution of distress, mean time to became asymptomatic and mean duration of days of hospital stay. Moreover, the results suggested that adjuvant supplement with zinc 20 mg per day accelerated the recovery from severe pneumonia in young children and reduced the duration of hospital stay.

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