Zinc Supplementation in Children with Acute Diarrhea

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Abstract

Background: To evaluate the effect of zinc supplementation on the outcome of acute diarrhea by comparing it with standard management of acute diarrhea in children.

Methods: In this interventional study, total 100 patients, 6 months to 5 years of age were enrolled and were randomly allocated in Group A or Group B . Group A was treated with standard management of acute diarrhoea whereas Group B was given zinc supplementation in addition to standard management protocols. Children were monitored for stool frequency, consistency , state of hydration and any complicating factor.

Results: The frequency of stools in group A and B reduced from 16.1 $\pm$ 4.4 8 stools/day and 15.66$\pm$ 4.24 stools/day to 6.80$\pm$ 1.99 stools/day and 1.78$\pm$ 1.79 stools/day respectively. The consistency of stools in group A and B changed from 3.9 and 3.8 on day one to 2.14 and 1.68 , respectively , on day 7.

Conclusion: The zinc supplementation had no effect on the outcome of acute diarrhoea in children. There was no significant reduction in the severity of acute diarrhoea in the children who were given the zinc supplements, in comparison to those who were managed with the standard treatment protocol.

Key Words: Acute diarrhoea, zinc supplementation, standardized treatment, frequency, consistency.

Introduction

Zinc is an essential micronutrient and second most abundant trace element in cells and tissues. It reduces the frequency of stools and stool output, when administered to children with acute diarrhea[1]

Acute diarrhoea remains a common illness among infants and children throughout the world. In developing countries diarrhoea remains a common cause of mortality among children less than 5 years of age, with an estimated 2 million deaths annually [2]. The combination of oral rehydration therapy and continued nutritional support has proven effective throughout the world in treating acute diarrhoea.

A number of studies have been conducted in different parts of the world to evaluate the role of zinc as an adjunct to fluid and dietary management of diarrhoea. Since zinc has been recognized as an anti oxidant, it counteracts the oxidative damage produced by the free radicals, which are responsible for intestinal malabsorption and diarrhoea. Zinc also inhibits the cAMP induced chloride ion secretion by blocking the potassium channels in basolateral membrane of intestinal epithelial cells[1].The data collected so far has been consistent with the fact that zinc supplements may deserve further attention as a means to scavenge free radicals responsible for acute diarrhea.

A study was conducted in Calcutta, India to determine the impact of zinc supplementation in malnourished children with acute diarrhea[3]. It was concluded that zinc was moderately efficacious in reducing the severity of acute diarrhea without increasing vomiting or reducing the ORS intake.

In Bangladesh, a community based randomized control trial was done to evaluate the effect on morbidity and mortality by providing daily zinc for 14 days . It showed that the lower rates of child morbidity and mortality from a simple and inexpensive intervention with zinc treatment provides substantial benefits for its incorporation in existing efforts to control diarrhoeal disease [4].Similar results have also been obtained by studies from other developing countries like Turkey , Norway and developed countries like Australia , USA and United Kingdom[5-10] .

In a Pakistani study serum zinc levels were studied in children with malnutrition and were found to be significantly low in children with acute or chronic diarrhoea associated with malnutrition[11].

A pooled analysis of the randomized control trials was conducted at the Aga Khan University Medical Centre, Karachi. The aim was to determine the therapeutic effects of oral zinc in acute and persistent diarrhoea in children in the developing countries. And it was concluded that zinc supplementation reduces the duration and severity of acute and persistent diarrhea[11].

Zinc supplementation has not been found to be associated with serious adverse effects. Decrease in

copper absorption has been noticed in a few patients with excessive zinc consumption over long periods of time[12].

As only a few studies been conducted in Pakistan on the effect of zinc in diarrhea, this study was conducted with the aim of collecting further supportive evidence about the role of zinc in acute diarrhea in order to recommend zinc supplementation in the standard care management of acute diarrhea.

Patients and Methods

It was a quasi experimental study conducted in the admitted patients of acute diarrhea in the Department of Pediatrics, Rawalpindi General Hospital. .The study was conducted over 1 year from 30th of June, 2006 to 29th of June 2007.

Total 100 patients between the age group of 6 months to 5 years were selected by convenient sampling and randomly distributed by a draw into 2 groups (Group A and Group B), with 50 patients in each group. The patients with >10 days duration of illness, with blood in stools, suspected cholera and co morbid conditions like acute respiratory infections , urinary tract infections , malaria and sepsis which require antibiotic therapy, were excluded from the study. Informed consent was taken from parents of the children enrolled for study.

Both the groups were kept under observation in the hospital for 3 days, then discharged. Two follow up visits; on day 7 and day 14 were done. Group A patients were treated with standardized management of acute diarrhoea, Oral Rehydration Salt (ORS) and continued feeding with yogurt, banana and rice. Group B patients were given zinc supplementation 10 mg/kg/day for 7 days, in addition to standard management protocol. During hospital stay, the patients were daily monitored for frequency and consistency of stools, state of hydration, symptoms and signs of other systemic illnesses and septicaemia and weight gain. On follow up visits, in addition to recording the above mentioned variables, average weight gain was also assessed. All the information was recorded on a specially designed proforma.Computer programme SPSS version 10 was used for data analysis. Independent sample t test was employed to test the hypothesis whereas frequencies were calculated for rest of the nominal data

Results

All the patients enrolled were between 6 months to 5 years of age, both male and female. At the time of admission / enrolment, the average mean duration of diarrhoea was 2.82 +/- 1.59 days in Group A and 2.98 +/- 1.65 days in group B. On day 1 following enrolment in the study, the patients in group A were passing 16.1 +/- 4.48 stools per day while the patients in group B were passing 15.66 +/- 4.24 stools per day (p value > 0.05). The frequency of diarrhoea was 14.4 +/- 4.48 stools/day in group A and 13.3 +/- 3.69 stools/day in group B on second day of hospitalisation (p value > 0.05). The frequency reduced to 10.66 +/-3.5 stools/day in group A and 3.48 +/- 2.88 stools/day in group B on third follow up day (p value > 0.05) and by the seventh day of treatment, the patients in group A were passing 6.80 +/- 1.90 stools per day while the patients in group B were passing only 1.78 +/- 1.79 stools per day (p value > 0.05) but the results remained statistically insignificant. Diarrhoea had settled in both the groups by day 14 and the mean number of stools was 2.0 and 1.74 in group A and B respectively.

As regards the consistency of stools, on the first day of treatment the mean consistency of stools was 3.9 and 3.88 in group A and B respectively (p value > 0.05). On day 2 , the consistency of stools was 3.78 in group A and 3.62 in group B (p value > 0.05).On day 3 , the group A patients were passing stools of consistency 3.26 and group B patients were passing stools of consistency 2.96 (p value > 0.005). The consistency of stools reduced to 2.14 and 1.68 in Group A and B respectively (p value 0.05) , by day 7 but the results were not statistically significant. By day 14 patients in both the groups, A and B were passing grade 1 stools.

Over 14 days of treatment and follow up , an average weight gain of 0.36 +/- 0.160 kg was observed in the Group A , as compared to 0.38 +/- 0.159 kg in Group B and the difference was statistically not significant (p value > 0.05)

Regarding the associated symptoms, there was no significant difference in the number of patients who had vomiting or fever, in both the groups. Also there was no significant difference regarding the state of hydration, the use of ORS and IV fluids and antibiotics between the two groups. None of the study patients developed other systemic illnesses like dysentery, UTI and pneumonia during the course of study so none of the patients received antibiotic therapy.

In four study patients, two from each group,

diarrhoea did not settle by day 14, so these patients were further worked up for persistent diarrhea.

Discussion

Acute diarrhoea is one of the commonest causes of mortality and morbidity among children in our country. Acute diarrhoea constitutes 40-50% of the hospital admissions especially during the summer and the rainy season. The standard management of acute diarrhoea cases admitted in our hospitals consists of intravenous and oral rehydration therapy and nutritional support. Antibiotics have a limited role only in dysentery, suspected cholera, and confirmed cases of giardiasis or evidence of systemic illness like pneumonia. Although the standardized management of diarrhoea has been highly successful in reducing the overall mortality due to diarrhoeal disease over the years, yet the awareness and compliance of the general population regarding the oral rehydration therapy has remained unsatisfactory. Now a days, the medical professionals and the health workers are making a great deal of effort in creating public awareness regarding the role of oral rehydration therapy and nutritional support in treating acute diarrhoea. Yet the patients continue to present in the hospitals in state of severe dehydration and diarrhoea associated complications. Over the last few years, a number of newer drugs have been subjected for experiments and clinical trials to identify their possible role in reducing the duration and severity of diarrhoea and ultimately the associated morbidity and mortality from diarrhoea. Zinc, a trace element, is one of them. This study was also carried out with the objective of identifying the effect of zinc supplementation on the outcome of acute diarrhoea in comparison with the standard management protocols. But the results revealed that the zinc supplementation had no effect on the outcome of acute diarrhea in children. There was no significant reduction in the severity of acute diarrhea in the children who were given the zinc supplements, in comparison to those who were managed with the standard treatment protocols.

These findings are contradictory to those of Bahl from India, who concluded that zinc and ORS combination was moderately efficacious in reducing the severity of acute diarrhoea without increasing vomiting or reducing ORS intake [13,14]. Similar conclusions were made from the studies of Lukacik from Georgia and Hoque from the Yale University School of Medicine [16,17]. Other Randomized Control Trials done in India , Bangladesh , Turkey, Norway , Australia and the USA , have found the zinc supplementation to be beneficial and cost effective in treating acute diarrhoea [1,3-10]. In Pakistan , the studies revealed that zinc supplementation reduces the duration and severity of acute and persistent diarrhoea [11]

One of the reasons for the study results to be statistically insignificant may be the small size of the study population. Another important factor may be the failure to address the precipitating factors of acute diarrhoea , esp. the lack of breast feeding , unhealthy dietary practices , unhygienic conditions and lack of parental education and awareness. During the three days of hospital stay, children in both the groups were provided uniform hygienic conditions and healthy diet and mothers were counselled regarding home care. But after discharge from the hospital , the parents may not have complied with the same principles. These confounding factors may have rendered the therapeutic interventions ineffective. Also the dose of zinc administered to the study patients was 1mg/kg for 7 days , whereas the dose now recommended by the WHO is 10mg daily in infants <6 months and 20 mg daily in older children [17,18].So the under dosage may have been another factor for the results of this study being insignificant.

However the results of this study closely correlate with those of Boran, from Turkey ,as in his study zinc supplementation had no effect on the duration and severity of acute diarrhea [19].Also the studies conducted by Brooks and Santosham in Bangladesh did not establish any beneficial effect of zinc in acute diarrhoea in young infants [20].Similar observations were made by Tielsch , from Baltimore , who assessed the effect of daily zinc supplementation in Nepalese children and found no effect on the frequency or duration of acute diarrhoea in children [21].

Another important aspect of the study was the fact that the patients remained compliant with the treatment and completed the 7 day course of oral zinc supplement as prescribed, without experiencing any adverse effects. This was consistent with the findings of a study done in Lucknow , India, wherein it was concluded that the children had good tolerance to zinc without any side effects [22].

Therefore, it may be concluded that the zinc supplements may offer promising results in reducing the diarrhoea associated morbidity, without the risk of any serious adverse effects. However further broad based studies are needed to assess the efficacy and cost

effectiveness of zinc, before it is added to the standard management protocol for treating acute diarrhoea.

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