Zinc Deficiency: a Contributing Factor of Short Stature in Growth Hormone Deficient Children

by Zeynep Şıklar, Ceyda Tuna, Yıldız Dallar *and* Gülten Tanyer
Ministry of Health Ankara Hospital, Department of Pediatrics, Turkey

Summary

Zinc is an essential trace element which affects growth by promoting DNA and RNA synthesis and cell division. Zinc deficiency causes growth retardation and its frequency is high in developing countries. It could contribute to the effect of growth hormone (GH) treatment in GH deficient children. In this study, we investigated zinc deficiency in GH children. Twenty-four GH deficient children (treated with GH for 2.2 ± 1.6 years) were recruited for the study. Intracellular erythrocyte zinc levels were measured. Eleven (45.9 per cent) were found to be zinc deficient (Group 1), while 13 patients (54.1 per cent) had normal zinc levels (Group 2). The mean growth velocity was 5.98 ± 0.8 cm/year in Group 1 and 6.9 ± 1.4 cm/year in Group 2. Group 2 was given oral zinc supplementation with a resultant growth velocity of 7.51 ± 0.5 cm/year. During GH treatment in GH deficient children, zinc status should be evaluated as severe zinc deficiency could affect the response to GH treatment.

Introduction

Zinc is an essential trace element and a cofactor of many metalloenzymes that are involved in numerous biochemical processes such as skin integrity, immunity, bone formation and tissue growth and development. Zinc deficiency results in depressed immunity, impaired taste, poor wound healing, delayed sexual maturation, growth retardation, weight loss, and abnormal dark adaptation.[1] Rapidly growing infants and children who have a diet of low bioavailability of zinc, are more prone to zinc deficiency.[2] Furthermore, zinc deficiency can be an important factor on the growth of growth hormone (GH) deficient children.[3]

We, therefore, aimed to evaluate zinc levels of GH deficient children.

Materials and Methods

Twenty-four GH deficient children (13 boys and 11 girls) who were treated with recombinant GH for at least 1 year, were recruited for the study. It is thought that the catch-up growth period during the first year of the GH treatment could effect the growth rate. Children with chronic systemic disorders, malabsorbtion, malnutrition, Turner syndromes and multiple hypophysal hormone deficiency were not included in the study.

We studied intraerythrocyter zinc levels by atomic absorption spectrophotometry. Normal intraerythrocyter zinc levels are 8.2–8.7 ng/ml. Eleven patients were found to be zinc deficient (Group 1) and 13 patients were found to have normal zinc levels (Group 2). Zinc supplementation was given in a dosage of 1 mg/kg/day for 6 months. The growth velocity of the study groups was evaluated for at least 6 months before and after the zinc treatment. Unfortunately we were unable to measure the insulin like growth factor-1 (IGF-1) levels in our study.

Statistical analysis was done between groups with respect to growth velocity by using the Mann–Whitney *U*-test.

Results

All patients were prepubertal and diagnosed as isolated GH deficient. The body mass index of the patients was normal and there was no statistically significant difference between the two groups. Patients' mean age was 9.3 ± 2.2 years (range 5.6 – 13.5 years). They had been treated with rhGH for 2.2 ± 1.6 years (range 1.1 – 4.3 years).

Group 1 (n = 11, 45.9 per cent) were both zinc-deficient and GH deficient children. Their mean age was 11.4 ± 2.1 years. Their GH treatment period was 2.6 ± 1.9 years. Before zinc supplementation, the growth velocity of group 1 was 5.98 ± 0.8 cm/year. At the beginning of the study, the mean zinc level of group 1 was 6.9 ± 1.1 ng/ml.

Group 2 was comprised of 13 GH deficient only children (54.1 per cent); mean age 10.7 ± 1.2 years. The rhGH treatment period was 2.0 ± 1.7 years. The initial growth velocity of Group 2 was 6.9 ± 1.4

Correspondence: Dr Zeynep Şıklar, Orman Fidanlık Iojmanları 23/4, 06560 Söğütözü, Ankara, Turkey. Tel. 0 312 2158254. E-mail <zeynepsklr@hotmail.com>.

Downloaded from https://academic.oup.com/tropej/article/49/3/187/1659517 by ANKARA UNIVERSITESI user on 12 December 2021

cm/year, and the intraerythrocyter zinc level was 8.8 ± 0.4 ng/ml.

After a 6-month period, in Group 1 the growth velocity was 7.51 ± 0.5 cm/year ($p < 0.05$); in Group 2 it was 6.8 ± 0.6 cm/year. Hence, the growth velocity increased in Group 1, but did not change in Group 2 after a 6-month follow-up period.

Only four patients complained of gastric irritation due to zinc. No other complications were seen.

Discussion

Zinc deficiency can be caused by an inadequate dietary intake, impaired absorbtion, excessive excretion or inherited defects in zinc metabolism.[2]

In Turkey, Aras[4] reported that except for upper-middle income families, the daily zinc intake was much lower than the recommended value of 15 mg/day.

Zinc has an important role in protein synthesis and IGF-1 synthesis can be impaired by zinc deficiency. A reduction in circulating IGF-1 concentrations has been proposed as a potential mechanism for growth retardation induced by zinc deficiency.[5] An important observation was the significant elevation in the IGF-1 level after zinc supplementation.[6] Unfortunately we were unable to measure the IGF-1 levels of our patients.

Lifshitz and Nishi[7] reported that zinc supplementation improved the growth in patients who had abnormal growth patterns without any other abnormality except hypozincemia.

During the rGH treatment, an increase in body growth could cause relative deficiency of essential elements such as zinc.[2] Cheruvanky, *et al.*[8] reported that 22 GH deficient children who were receiving hGH, were given 50 mg of oral zinc supplementation daily for a year and had an increased growth rate from 5.1 to 7.3 cm/year. In our study, the incidence of zinc deficiency among the hormone deficient children was 45.8 per cent while receiving GH treatment, and growth velocity increased with zinc supplementation. Six months is a very short time to follow-up, and an increased case number and follow-up time is desirable. Furthermore, controlling the IGF-1 serum level will also help to emphasize the effect of zinc supplementation.

Zinc deficiency could be a contributory factor to the decrease in growth in children with growth disorders. Especially in zinc-deficient countries such as Turkey, zinc deficiency should be kept in mind for its effect on growth, while treating GH deficiency with rhGH.

References

1. Polysangam A, Falciglia GA, Brehm BJ. Effect of marginal zinc deficiency on human growth and development. J Trop Med 1997; 43: 192–97.
2. Ince E, Kemahlı S, Uysal Z, Akar N, Cin Ş, Arcasoy A. Mild zinc deficiency in preschool children. J Trace Elem Exp Med 1995; 7: 135–41.
3. Collip PJ, Castro Magana M, Petrovic M. Zinc deficiency; improvement in growth and growth hormone levels with oral Zn therapy. Ann Nutr Metab 1982; 26: 287–90.
4. Aras NK. Dietary intake of zinc in Turkey. In Abdulla M, *et al.* (eds), New Aspects of Trace Element Research. Smith-Gordon, London, 1999; 269–71.
5. Prasad A. Zinc and growth. J Am Coll Nutr 1996; 15: 341–42.
6. Nakamura T, Nishiyama S, Suginohara YF, Matsuda I, Higashi A. Mild to moderate zinc deficiency in short children. J Pediatr 1993; 123: 65–9.
7. Lifshitz F, Nishi Y. Mineral deficiency during growth. In DeLuca HF, Anast CS (eds), Pediatric Disease Related to Calcium. Elsevier, New York, 1980: 305–21.
8. Cheruvanky T, Magana MC, Chen SY, Collip PJ, Maibodi ZG. Effect of growth hormone on hair, serum and urine zinc in growth hormone deficient children Am J Clin Nutr 1982; 35: 668–70.

Downloaded from https://academic.oup.com/tropej/article/49/3/187/1659517 by ANKARA UNIVERSITESI user on 12 December 2021