

Relationship between deficiencies in vitamin A and E and occurrence of infectious diseases among children

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Abstract. – OBJECTIVE: To investigate the relationship between vitamin A deficiency (VAD), vitamin E deficiency (VED) and infectious diseases.

PATIENTS AND METHODS: We chose 684 cases of healthy children age 5 months-12 years from our hospital, measured their VA, VE from vein under the light proof condition with high-pressure liquid chromatography. Thereafter, the children who get the acute respiratory tract infection (ARI) or diarrhea two weeks later were registered.

RESULTS: After the two weeks trial (N=684 cases), the VA level of children with ARI was lower than that of children without ARI (0.23 ± 0.02 mg/ml/ 0.33 ± 0.01 mg/ml), $p < 0.05$. Moreover, the VE level of children with ARI was significantly lower than that of children without ARI ($p < 0.05$). Most interestingly, the proportion of children with diarrhea accompanied with decreased VA level in serum was higher than that of children without diarrhea, indicating that VA level < 0.2 mg/L more easily affected acute respiratory tract infection.

CONCLUSIONS: We were able to demonstrate that Children who presented vitamin A deficiency were easier to get the acute respiratory tract infection (ARI) and diarrhea. Children who presented vitamin E deficiency were easier to get the acute respiratory tract infection (ARI). Vitamin A and vitamin E deficiencies are one of the important factors related to occurrences of acute infectious diseases in children.

Key Words:

Vitamin A, Vitamin E, Diarrhea, Acute respiratory tract infection (ARI), Children.

Introduction

Vitamin A and E are micronutrients, which play an important role in human beings, and they are essential especially for children. Vitamin A has been considered as serious children's health pro-

blem to be dealt in 21 century at World Summit for Children¹. More and more domestic and overseas researchers have participated in the research of Vitamin A deficiency and found that Vitamin A deficiency does not only lead to blindness and xerosis but also affects children's immune system to cause respiratory tract infection, digestive canal infection and anemia². Vitamin E deficiency can cause permanent damage to children's reproduction, development and vision³. Compared with Vitamin A deficiency, Vitamin E deficiency has attracted little attention, especially the relationship between it and infectious diseases needs to be studied. Our research studied the relationship between Vitamin A deficiency, Vitamin E deficiency and respiratory tract infection, digestive canal infection to guide prevention and treatment.

Patients and Methods

Patients

Six hundred and eighty four (684) healthy children aged 5 months-12 years (352 boys and 332 girls) were selected from March 2014 to May 2016 in our hospital. The children with ARI or diarrhea in one week were excluded. This study was approved by the Ethics Committee of Daqing Longnan Hospital. Signed written informed consents were obtained from the parents of the participants before the study.

Methods

Venous blood (2.5 ml) was collected under the light proof condition, serum was separated immediately, stored in a low-temperature refrigerator and sent to Heilongjiang Harmony Health Medical Laboratory Co., Ltd. to measure the VA and VE with HPLC⁴, the whole procedure was limited in 3 hours.

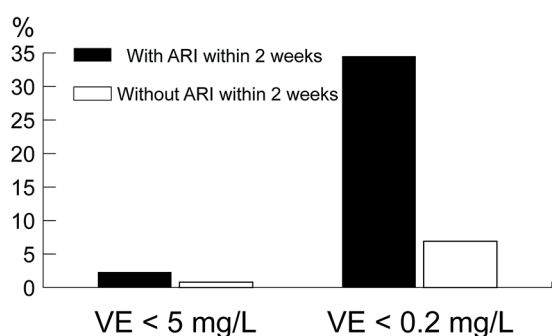


Figure 1. The proportion of children with (without) ARI caused by VAD or VED within 2 weeks.

Judgment Standards of VAD and VAE

VA and VE levels in serum were measured, VA < 0.2 mg/L was judged as deficiency, 0.2 mg/L ≤ VA < 0.3 mg/L was judged as suspicious deficiency, VE < 5 mg/L was judged as deficiency, and 5 mg/L ≤ VE ≤ 7 mg/L was judged as suspicious deficiency⁵⁻⁷.

Statistical Analysis

Statistical analyses were performed using SPSS20.0 (SPSS Inc., Chicago, IL, USA), the data were analyzed using a *t*-test, and *p* < 0.05 was considered to indicate significant differences.

Results

Relationship between VA, VE Levels (mg/L) and ARI

After two weeks, the VA level of children with ARI was lower than that of children without ARI; the difference was statistically significant (*p* < 0.05). The result indicated that VAD was an important factor affecting ARI, which was consistent with other research conclusions^{8,9}. The VE level of children with ARI was lower than that of children without ARI, the difference was statistically significant (*p* < 0.05), and this indicated that VED was another important factor affecting ARI (Table I and Figure 1).

Relationship Between VA, VE Levels (mg/L) and Diarrhea

After two weeks, the proportion of children with ARI (diarrhea) accompanied with VA level in serum < 0.2 mg/L (VE < 5 mg/L) was higher than that of children without ARI (diarrhea), which indicated that VA level < 0.2 mg/L (VE < 5 mg/L) more easily affected acute respiratory tract infection.

Table I. Relationship between VA, VE levels (mg/L) and ARI.

	n	VA	VE
With ARI in 2 weeks	220	0.23 ± 0.02	8.24 ± 0.04
Without ARI in 2 weeks	464	0.33 ± 0.01	9.25 ± 0.02

Moreover, at the same time, the VA level of children with diarrhea was lower than that of children without diarrhea (*p* < 0.05). The VE level of children with ARI was slightly lower than that of children without diarrhea, the difference wasn't statistically significant (*p* > 0.05). The results indicated that VAD had important effects on the occurrence of diarrhea, but VED didn't (Table II).

After the analysis time, the proportion of children with diarrhea accompanied with VA level in serum < 0.2 mg/L is much higher than that of children without diarrhea, which indicates that VA level < 0.2 mg/L more easily affected acute respiratory tract infection. The proportion of children with diarrhea accompanied with VE level in serum < 5 mg/L is much higher than that of children without diarrhea, which indicates that VE level < 5 mg/L more easily affects diarrhea (Figure 2).

Detection of Blindness and Xerosis Caused by Vitamin A Deficiency

The detection rate of blindness and xerosis caused by Vitamin A deficiency is much higher in China¹⁰. The investigation of children under age 7 with VAD in 14 provinces in China from December 1999 to December 2000 showed that the proportion of children with VA level in serum < 0.2 mg/L is 11.7%¹¹. Our study selected 684 children, including 108 children with VA level < 0.2 mg/L, and the detection rate of VAD is 16% which is higher than 11.7%, the proportion of children

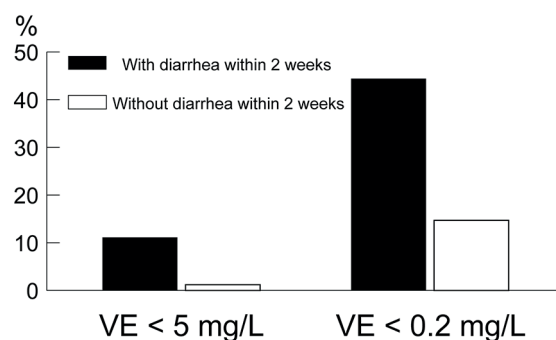


Figure 2. The proportion of children with (without) diarrhea caused by VAD or VED within 2 weeks.

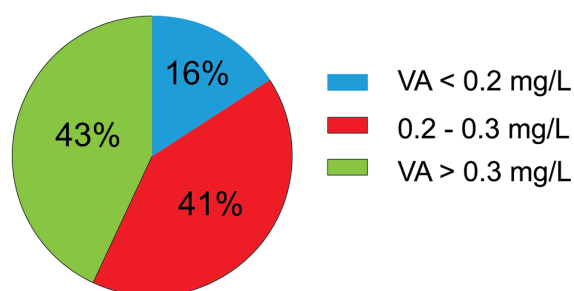


Figure 3. The corresponding proportion of children with various VA level.

with VAD and suspicious VAD is as high as 57% which indicated that VAD is a serious children's health problem in our city (Figure 3).

Our investigation showed that the proportion of children with VED and suspicious VED is 25%, which is lower than that of VAD, but VED should be taken seriously because it increases the incidence of ARI (Figure 4).

Discussion

VAD increases the incidence of respiratory tract infection and digestive canal infection, and children with diarrhea or respiratory tract infection are more easily affected by dry eye^{12,13}. VA plays roles in vision formation, children's growth, and maintenance of reproductive system, immune process and improvement of resistance to infections. (1) VA protects the integrity of mucosa, maintains the normal physiological metabolism of respiratory epithelial and digestive epithelial and stimulates the secretion of S-IgA to improve local immunity. (2) VA promotes the synthesis of steroid hormone, increases the ratio CD4/CD8 and affects Th cells to improve immunity^{14,15}. Meanwhile, VA can increase the number of NK cells and its activity¹⁶.

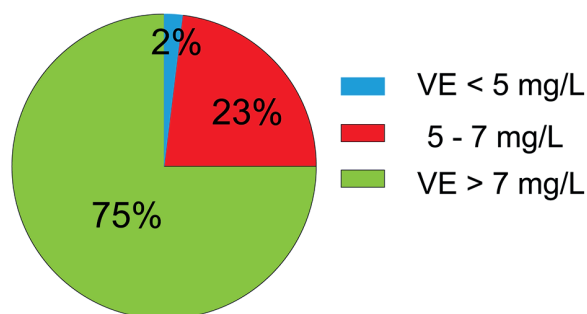


Figure 4. The corresponding proportion of children with various VE level.

Table II. Relationship between VA, VE levels (mg/ L) and diarrhea.

	n	VA	VE
With diarrhea	9	0.17±0.03	7.74±0.06
Without diarrhea	675	0.29±0.02	8.51±0.04

Note: $p < 0.05$ for VA diarrhea, $p > 0.05$ for VE and diarrhea

A previous study¹⁷ indicated that the appropriate amount of VE was injected in chick embryo to improve the immune response of chickens and increased the level of immune-related factors in serum. In vitro Experiments also showed that VE promoted the synthesis of related antibodies¹⁸. Lee et al¹⁹ found that VE improved the responses of human T lymphocytes to phytohemagglutinin and lipopolysaccharide, promoted proliferation of T lymphocyte. Meanwhile, VE increased the chemotaxis and phagocytic activity of macrophage, promoted the release of IL-2, improved the activity of NK cells and strengthened the anti-parasitic infections²⁰. In a word, VE enhances cellular immunity and humoral immunity²¹. Up-regulation of T lymphocyte function affects the signal transduction pathway to improve children's immunity. Nowadays, domestic and oversea scholars proposed that the low VA level was mainly caused by malnutrition²¹, so parents' cognition about VAD needs to be improved and foods rich in VA should be supplemented to children.

Conclusions

Relatively malnutrition is not the principal cause of VED, which can induce various disease such as thalassemia and cholestasis liver diseases as well as absorption function impairment of intestinal tract, so the identification of cause is very important to eliminate VED.

Conflicts of interest

The authors declare no conflicts of interest.

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