RESEARCH

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Vitamin A, Vitamin D, Zinc and Iron Levels in Children Undergoing Adenoidectomy and Placement of Tympanostomy Tubes

ABSTRACT
Objectives: Adenoidectomy and the placement of tympanostomy tubes are among the most commonly performed surgical procedures in ear nose and throat clinics. Systemic and local causes have been implicated in the pathophysiology leading to these procedures. The aim of this study was to investigate a possible association between levels of vitamin A, vitamin D, iron, and zinc need to undergoing adenoidectomy and placement of tympanostomy tubes.
Material and Methods: Demographic and disease-specific data were obtained from 31 Turkish children undergoing adenoidectomy and the placement of tympanostomy tubes, and 14 controls. Blood samples were taken for measurement of vitamin A, zinc, iron, and 25-hydroxy vitamin D (25[OH]D). All measurements were done in the same laboratory by the same researcher.
Results: The study group comprised 13 (41.9%) girls and 18 (58.1%) boys, and the control group 7 (50%) girls and 7 (50%) boys. There were no statistically significant differences between study and control groups in plasma 25(OH)D, iron, zinc, or vitamin A levels ($p>0.05$).
Conclusions: This pilot study did not show an association between serum vitamin D, iron, zinc, and vitamin A and the need to have an adenoidectomy and placement of tympanostomy tubes.
Key words: Adenoidectomy, Tympanostomy Tube, Vitamin D, Vitamin A, Zinc, Iron.

Adenoidektomi ve Kulaklara Ventilasyon Tüpü Takılan Çocuklarda Vitamin A, Vitamin D, Çinko ve Demir Düzeyleri

ÖZET
Amaç: Adenoidektomi ve kulağa ventilasyon tüpu takılması islemleri kulak burun boğaz kliniklerinde en sık uygulanan cerrahi işlemler arasında yer almaktadır. Bu işlemlere yol açan patofizyolojik mekanizmadan birçok sistemik ve lokal faktör sorumlu tutulmaktadır. Bu çalışmamızda adenoidektomi ve kulaklara ventilasyon tüpleri takılması ameliyatları yapılan çocuklarda, A vitamini, D vitamini, demir ve çinko düzeyleri arasında olası bir ilişkinin araştırılması amaçlanmıştır.
Materyal ve Metod: Adenoidektomi ve kulaklara ventilasyon tüpü takılması islemi yapılan 31 hasta ve 14 sağlıklı çocuğun demografik yapıları ve hastalığa özgü verileri araştırıldı. A vitamini, çinko, demir ve 25-hidroksi vitamin D (25 [OH] D) ölçümü için kan örnekleri alındı. Tüm ölçümler aynı araştırmacı tarafından aynı laboratuvarda yapıldı.
Bulgular: Çalışmaya toplam 45 çocuk dahil edildi. Çalışma grubu 13 (%41.9) kız ve 18 (%58.1) erkek, kontrol grubunda 7 (%50) kız ve 7 erkek (% 50) oluşmaktadır. Plazma 25(OH)vitamin D, demir, çinko ve A vitamini düzeyleri açısından çalışma ve kontrol grupları arasında istatistiksel olarak anlamlı fark, görülmedi ($p<0.05$).
Sonuç: Çalışmamızda, serum vitamin A, vitamin D, demir ve çinko düzeyleri ile adenoidektomi ve kulağa ventilasyon tüpü takılması ihtiyacı arasında anlamlı bir ilişki görülmemiştir.
Anahtar kelimeler: Adenoidektomi, Timpanostomi Tüpü, D Vitamini, A Vitamini, Çinko, Demir.

INTRODUCTION

Adenoidectomy and the placement of tympanostomy tubes are among the most commonly performed surgical procedures in pediatrics. Systemic and local inflammation has been implicated in the pathophysiology leading to these procedures (1).

Vitamins are essential components of the diet and have been known to influence the immune system (2). Vitamin D is known to have many immunologic effects, including effects on T cells, macrophages, and dendritic cells (3). Vitamin D deficiency has been linked to a high rate of both infectious and inflammatory diseases, including those of the upper and lower airways such as rhinosinusitis, pneumonia, influenza A, and otitis media (4).

Vitamin A is a fat-soluble vitamin that plays an essential role in a large number of physiological functions and is essential for immune cell differentiation, growth, reproduction, and maintenance of gastrointestinal and respiratory epithelial surfaces (5,7). Despite advances in knowledge of the importance of vitamin A, its deficiency remains a serious public health problem. Hyporetinolemia has been linked to immune dysfunction, including increased risk of mortality and morbidity from measles, diarrheal diseases, blindness, anemia, and respiratory tract infections (6,8). Hyporetinolemia is a significant factor in the etiology of acute and chronic suppurative otitis media (5,6). Vitamin A supplementation has been reported to reduce morbidity rates associated with pneumococcal disease by delaying the rate of colonization and the age of occurrence (9).

Some reports indicate an effect of Vitamin A in increasing iron mobilization from the liver and iron absorption from enterocytes. Without iron supplementation, vitamin A may help to decrease the prevalence of anemia and improve the innate immune response in preschool children (10,11). Zinc is an essential element for development and growth in children. Its deficiency is associated with increased risk of infection, particularly diarrhea and pneumonia. The use of sufficient zinc supplementation in children aged two to 59 months has been recommended to prevent pneumonia (12).

We hypothesized that children undergoing adenoidectomy and the placement of tympanostomy tubes would have lower levels of vitamin D, vitamin A, zinc, and iron compared to controls.

MATERIAL AND METHODS

We performed a pilot study on 31 children and 14 controls undergoing adenoidectomy and the placement of tympanostomy tubes. The study was approved by the Ethics Committee of the Medical Faculty at the University of Abant İzzet Baysal in Bolu, Turkey. Patients taking multivitamins containing vitamin D, vitamin A, zinc, and iron for at least 6 months, and those on systemic steroids, non-steroidal anti-inflammatory agents, or undergoing recurrent tonsillitis were excluded. None had a history of rickets. The control group was matched to the study group for age, sex, and body mass index (BMI). Weight and height were determined using a digital electronic balance and a digital stadiometer, respectively. BMI was calculated as weight/height (kg/m^2). Blood was obtained at the time of insertion of the intravenous catheter after induction of general anesthesia. All specimens were stored until assayed for levels of 25-hydroxy vitamin D (25[OH]D), vitamin A, zinc and iron by the central laboratory.

Biochemical survey

All measurements were done in the same laboratory, by the same researcher with the same kit. Serum 25-hydroxyvitamin D level was detected by enzyme linked immunosorbent assay (K 21101, Immune Diagnostic,Germany). Serum Vitamin A levels were determined by simultaneously using high-performance liquid chromatography assay (Catalog No. CSB-E07889h, ELISA, CUSABIO, China). Serum Zincs levels were determined by Quantitative Colorimetric Zinc Determination assay. (Quanti Chrom™ Zinc Assay Kit, Bıoassay Systems, USA), and serum iron levels were detected by Quantitative colorimetric iron Determination teste (QuantiChrom™ Iron Assay Kit, Bioassay Systems, USA).

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) 11.5 software (SPSS Inc., Chicago, IL, United States). The distribution of continuous variables was determined using the Shapiro-Wilk test. Data were shown as mean±standard deviation or median (min-max) where applicable. Mean differences were compared using the Student's t-test, and median values using the Mann Whitney U test. Nominal data were evaluated by means of Fisher's exact test. A p value less than 0.05 was considered statistically significant.

RESULTS

The study comprised 31 patients (13 girls [41,9%] and 18 boys [58,1%]) undergoing adenoidectomy and placement of tympanostomy tubes and 11 controls (7 girls [50%] and 7 boys [50%]).

The median age (mean±SD) was 7.0±2.2 years in the study group and 7.6±1.6 years in the control group. The BMI (mean±SD) was 20.8±2.20 in the study group and 22.0±2.14 in the control group. There were no statistically significant differences between the control and study groups in plasma 25(OH)D, iron, zinc, or vitamin A levels ($p<0.05$) (Table 1).

DISCUSSION

Otitis media with effusion (OME) is a common, multi-factorial, asymptomatic, and silent disease, especially during infancy. Local and systemic inflammation has been implicated in the pathophysiology of this disease. Adenoid hyperplasia plays an important role in the etiology of OME; in patients with recurrent episodes of OME, adenoidectomy and the placement of tympanostomy tubes are indicated (13).

Vitamins A and D have received particular attention in recent years. These vitamins have been shown to have a crucial effect on the immune system and in the prevention and treatment of inflammation and autoimmunity (2).

Table1. Demographic and clinical data of cases

Variables	Control group	Study group	*p*-value
AGE (years), mean±SD	7.6±1.6	7.0±2.2	0.421[a]
GENDER, n (%)			1.000[b]
Male	7(50)	18 (58.1)	
Female	7(50)	13 (41.9)	
BMI (kg/m^2), mean±SD	22.0±2.14	20.8±2.20	0.127[a]
25(OH)D (ng/mL), median (min-max)	22.1 (12.5-54.9)	21.3 (23.1-57.6)	0.480[c]
Vitamin A (**µ** g/dL), median (min-max)	36.6 (32.2-61.2)	34.2 (23.1-57.6)	0.131[c]
Fe (**µ** g/dL), mean±SD	61.4±8.56	56.6±17.24	0.250[a]
Zn (**µ** g/dL), mean±SD	81.3±9.11	77.0±9.15	0.194[a]

a: Student's t test, b: Fisher's exact test, c: Mann Whitney U test

According to recent evidence, in addition to its traditionally recognized role in the endocrine system, vitamin D has a protective role in inflammatory infectious diseases. It is essential for the production of endogenous antimicrobial peptides, and deficiency has been linked to a high rate of both infectious and inflammatory diseases of the upper and lower airways, including influenza A, pneumonia, otitis media, and rhinosinusitis (4), as well as inadequate bone mineralization, causing rickets in growing children and osteomalacia in adults (14). However, a pilot study showed no association between the need to have adenotonsillectomy and serum vitamin D level (15). Similarly, our study showed no association between serum vitamin D level and the need for adenoidectomy and placement of tympanostomy tubes. Retinol represents the retinoid compounds referred to as vitamin A. After ingestion it is transported via the lymphatic system to the liver, where it is stored or transported to target organs bound to the retinol-binding protein (2,5). Vitamin A plays crucial role in a large number of physiological functions, including growth, reproduction, hematopoiesis, vision, and immunity (6). Vitamin A deficiency affects immunological functions such as respiratory tract infections and increases risk of mortality and morbidity from measles, diarrheal diseases, and blindness (5,16). It has been reported that by delaying the rate of colonization and the age of occurrence, vitamin A supplementation has reduced morbidity associated with pneumococcal disease (16). In ASOM patients compared to controls, hyporetinolemia suggests a significant association between retinol deficiency and development of ASOM (5). However, our study did not show an association between serum vitamin A and the need for adenoidectomy and placement of tympanostomy tubes.

Several reports indicate an interrelationship between iron metabolism, vitamin A, and immunological response in preschool children. Supplementation of vitamin A helps to decrease vitamin A deficiency and improve the hematological condition of anemic children. Vitamin A increases iron mobilization from the liver (10). Zinc is important for both humoral and cellular immunity. It modulates host response to infection by enhancing skin and mucous membrane barriers, cytokine expression, and leukocyte function (17). Low plasma zinc concentration in children has been associated with greater susceptibility to infection, and good zinc status with an increased immune response (18). Previous studies have linked low levels of zinc and iron to tonsil disease (19,20). However, there was no statistically significant iron or zinc deficiency among our population.

Our hypothesis that children undergoing adenoidectomy and the placement of tympanostomy tubes would have lower levels of vitamin D, vitamin A, zinc, and iron compared to controls was not supported by our study among Turkish children.

Limitations of the current study include its relatively small sample size. A larger study is needed before further conclusions can be drawn.

In conclusion, our pilot study did not show an association between serum vitamin D, vitamin A, zinc and iron and the need to undergo adenoidectomy and placement of tympanostomy tubes in Turkish children.

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