Relation between serum levels of Vitamin D and Immunoglobulin E in Allergic Rhinitis in Upper Egypt

Aida A. Abdelmaksoud[a], Shamardan ES.Bazeed[b], Mohamed F.Alemam[c], Zaky F.Aref[a]

[a]ENT Department, Faculty Of Medicine, South Valley University,Qena, Egypt.
[b]Tropical Medicine and Gastroenterology Department, Faculty Of Medicine, South Valley University,Qena, Egypt.
[c]Clinical and Chemical pathology Department, Faculty Of Medicine, South Valley University,Qena, Egypt.

Abstract

Objective: The object of this study is to evaluate the relation between 25-hydroxycholecalciferol (vitamin D_3) deficiency and allergic rhinitis by detecting level of 25-hydroxy cholecalciferol and Immunoglobulin E serum levels.

Methods: This is a case-control study in which we compare two groups; group A included 69 patients diagnosed as allergic rhinitis (AR) and group B included 60 healthy individuals. Serum levels of cholecalciferol and serum levels of immunoglobulin (IgE) were assessed in all participants of both groups of this study.

Results: Serum level of 25- hydroxycholecalciferol in group A (AR patients) was statistically significantly lower (mean±SD:14.2±8.04 ng/ml) than serum level of 25-hydroxycholicalciferol in group B (21.1±8.2ng/ml). Also serum level of IGE in group A was markedly elevated in comparison to group B (494.4±61.7u/l) vs. (189.9±52.9u/l) with highly statistically significant difference (p-value < 0.001).

Conclusion: There is statistically significant relation between 25-hydroxy cholecalciferol deficiency and allergic rhinitis; further studies must be done to assess the effect of Vitamin D_3 therapy in allergic rhinitis.

Key words: Allergic rhinitis, IgE, Vitamin D, hydroxycholecalciferol

Introduction

Allergic Rhinitis is a common inflammatory disease of the mucosal linings of the nose and paranasal sinuses.Immunoglobulin E (IgE) has a major role in such disease (**Small et al., 2018**). Severity of the AR can be assessed objectively by counting the serum IgE level (**Bauchau and Durham, 2004**). The exact pathogenesis of AR is not clear (**Tian and Cheng, 2017**). Vitamin D is known to be an important nutrient for the human body, particularly in absorption of dietary calcium and phosphate (**Akbar and Zacharek, 2011**).

Vitamin D is not a true vitamin but considered to be a steroid hormone (**Norman, 2008**). Vitamin D has 2 main forms, cholecalciferol (vitamin D_3) and ergocalciferol (vitamin D2). Both forms can

be found in foods or supplements; however, only vitamin D_3 is produced in skin (**Kamen**and **Tangpricha, 2010**) and it is the only naturally occurring form of VD in animals and humans (**Kamen and Tangpricha, 2010**).

Vitamin D deficiency has been considered as one of the worldwide health problems which may lead to many acute and chronic diseases (**Small et al., 2018**). Many researches considered this deficiency as a causative or predisposing factor in allergic diseases such as asthma (**Tian and Cheng, 2017**). Some studies have also documented that vitamin D_3 deficiency is an etiological factor in AR (**Aryan et al., 2017**).

The level of vitamin D_3 influences the activity of different cells of the immunity system. It also has a direct effect upon the activity of various cytokines and immunoglobulins, which have a great role in allergic diseases (**Bakhshaee et al., 2019**). In Egypt, Vitamin D insufficiency has recorded as epidemic proportions. It's more common among females (**Raef et al., 2019**).

Aim of the work

This study was conducted to evaluate the relation between 25-hydroxy cholecalciferol(vitamin D_3)deficiency and allergic rhinitis by detecting level of 25-hyrdoxy cholecalciferol and Immunoglobulin E serum levels.

Patients and Methods

This is a case-control study which was conducted in the Department of Otorhinolaryngology, Qena University Hospital, South Valley University, Egypt; an institutional ethical committee approval was taken. Informed Consent was obtained from all patients and controls in the study after explaining the concept and steps of the research. The study was conducted from January 2019 to June, 2020. Sixty nine patients with AR (group A) and sixty healthy persons as controls (group B) were included. Patients with AR were diagnosed clinically by symptoms of Allergic Rhinitis (runny nose, nasal congestion or obstruction, sneezing and itchy nose).

The diagnosis of allergic rhinitis is based on full history and clinical ENT examination. The severity degree of the disease was assessed by total nasal symptom score. The total nasal symptom score (nasal congestion, sneezing, an itchy nose and runny nose) was assessed according to the severity of each symptom. The degree of severity of any symptom was scored according to the followings: 0 = no detected symptom; 1 = mild symptoms; 2 = moderate, tolerable symptoms; and 3 = severe symptoms, interfere with daily activities or sleeping. Score 12 was the maximum severe symptoms (**Restimulia et al., 2018**).

Patients with score less than eight were considered as tolerable symptoms and those with score eight or more were considered as severe symptoms. The exclusion criteria Acute respiratory tract infections (upper and lower), obstructive nasal diseases as (severe sepal deviation, acute and chronic paranasal sinusitis), asthma under treatment, anemia, hypocalcaemia, severe hypertension, coronary heart disease, pregnant and lactating mothers, liver and renal impairment, damaged blood preparation, and failure of examination, also those with allergic rhinitis under medical treatment.

Serum IgE levels and Serum 25-hydroxycholicalciferol (25(OH) D) were

measured for all participants. IgE levels were assessed by Enzyme Linked Immunosorbent Assay (ELISA) kit for quantitative detection of humane IgE (Invitrogen, BMS2097.Thermo Fisher.Vienna, Austria) according to manufacturers instructions. IgE levels >150 IU/mL were considered as elevated (**Gani and How, 2015**).

The serum vitamin D levels were detected by the electrochemiluminescence immunoassays method (ECLIA) using fully automatedGobasE411 (Roche Diagnostic GmbH,Mannheim,Germany) hormone-immunoassay analyser. Serum vitamin D is considered as Normal when 25(OH)D level is between 30-60ng/mL, while 25(OH)D <20 ng/mL was considered as deficiency of vitamin D, while levels of 20-30 ng/mL showed insufficiency of vitamin D, and if 25(OH)D > 50 ng/mL indicated optimal levels (**Novak and Bieber, 2003**).

Statistical analysis: Data were analyzed using Statistical Program for Social Science (SPSS) version 24. Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. Mean (average): the central value of a discrete set of numbers, specifically the sum of values divided by the number of values.

Standard deviation (SD): is the measure of dispersion of a set of values. The values tend to be close to the mean of the set is considered to be low SD, while the values spread out over a wider range is considered to be high SD. The following tests were done: Independent-samples t-test of significance: was used when comparing between two means.

Chi-square test: was used when comparing between non-parametric data. Probability (P-value) P-value < 0.05 was considered significant. P-value < 0.001 was considered as highly significant. P-value > 0.05 was considered insignificant.

Results

The study sample included 69 patients with AR (Group A) and 60 healthy persons (Group B). Among (Group A), there were 45 female patients (65.2%) and 24 male patients (34.8%) and in (Group B) there were 36 female persons (60%) and 24 male persons (40%) with statistically insignificant difference (Table 1).

Group A mean age (27.3 ± 10.1) years in comparison to group B that had a mean age of (29.5 ±11.3) years with p-value: 0.351 with no statistical significant difference (Table 1).

AR patients of group A had elevated mean levels of serum IgE in comparison to the controls of group B (494.4±61.7) vs (189.9± 52.9) IU/L with highly statistical significant difference (p-value < 0.001) (Table 1).

Serum level of 25-hydroxy cholecalciferol in group A patients were statistically significant lower than group B (14.2 ± 8.04 vs. 21.1 ± 8.2) with p-value < 0.05 (Table 1).

According to the severity of symptoms patients with AR included 42 tolerable patients (60.9%) with total nasal symptom score less than 8, and 27 patients with severe symptoms (39.1%) with total nasal symptom score ≥ 8 (Table 2).

As regard age and sex. No statistically significant difference between tolerable and severe AR patients (Table 2). IgE serum levels were higher in severe AR patients

than tolerable patients but no statistical significant difference (p-value > 0.05). (Table 2)

25-hydroxy cholecalciferol serum levels were statistically significant lower in severe AR patients than tolerable patients (p-value < 0.001) (Table 2).

Table 1.Comparison between group A (AR patients) and Group B (healthy control) as regard Age, Sex, IgE and Vitamin D_3 levels

Variable	Group A (n=69)	Group B (n=60)	P-value
Age (Mean±SD)	27.3±10.1	29.5±11.3	0.495 NS*
Sex Male Female	 24(34.8%) 45 (65.2%)	 24 (40%) 36 (60%)	0.724 NS*
IgE (IU/L) (Mean±SD)	494.4±61.7	189.9±52.9	**< 0.001 HS****
Vitamin D_3 (ng/ml) (Mean±SD)	14.2±8.04	21.1±8.2	**0.008 S*****

- *not significant
- ** highly significant
- *** significant

Table 2.Comparison between patient with tolerable and severe AR as regard Age, Sex, IgE and Vitamin D_3 levels

Variable	Tolerable (n=42)	Severe (n=27)	P-value
Age (Mean±SD)	27.7±9.5	26.4±11.4	0.763 NS*
Sex Male Female	 12 (28.6%) 30 (71.4%)	 12 (44.4%) 15 (55.6%)	0.435 NS
IgE (IU/L) (Mean±SD)	485.6±57.1	507.9±69.5	0.410 NS
Vitamin D_3 (ng/ml) (Mean±SD)	18.8±6.5	7.06±3.9	**< 0.001 HS****

- *not significant
- ** highly significant

Discussion

In Egypt, vitamin D deficiency has a high prevalence especially in females (**Botros et al., 2015**) which is similar to results of this

study. Results of this study showed that there is vitamin D deficiency in both groups (group A and group B) but AR (group A) had significantly lower mean levels of serum vitamin D in comparison to the control (group B), similar results reported by (**Restimulia et al.,2018**).

In addition to skeletal effects, vitamin D has non skeletal actions, including immunity modulator effect (**Jadoon et al., 2017**). There is an inverse relationship between Serum vitamin D levels and IgE, which is proved to be a mediator in allergic immune responses. In this study patients with low serum levels of vitamin D have elevated serum levels of IgE which is similar to **Wimalawansa, 2018.**

Similar study was done by **Yalcinkaya and his colleges in 2015** showed that the serum levels of vitamin D of AR patients were lower than the non-AR group; another study done **by Restimulia et al., 2018** reported the same results. Vasiliou et al., 2014; reported that low serum levels of vitamin D related to other allergic diseases as asthma. **Kerley et al., 2016**; assessed the effect of vitamin D3 supplementation (2,000 IU/day, for 15 weeks) in asthma during childhood in Ireland, and they found advantageous changes of vitamin D therapy in parameters of bronchial asthma compared to placebo. Another cross-sectional study of 170 children divided into; (group of asthmatic patients and another control group),done in Turkey. the mean 25(OH) D_3 level in the asthma group was significantly different from that of the control group, and decreased levels of 25(OH) D_3 showed exaggerated degree of severity of asthma,(**Uysalol et al., 2013**).

An Indian study found that 91% of the AR patients had vitamin D deficiency and there was a significant improvement among allergic rhinitis patients after administration of vitamin D (**Modh et al., 2014**). Another study established a strong, negative relationship between serum vitamin D levels with the incidence of AR and severity of the disease (TNSS).

There is an important role of vitamin D in the AR symptoms (**Restimulia et al., 2018**). Hypponen et al, found that serum level of vitamin D had a significant negative correlation with IgE (**Hypponen et al., 2009**). Also, **Milovanovic et al., 2010** reported the same negative correlation between serum levels of vitamin D and IgE.

According the above findings, there is an important modulator effect of vitamin D on immune system which improves symptoms of allergic rhinitis. In addition, there are also studies that have found no relation between vitamin D supplement intake in mid-pregnancy and children with AR (**Maslova et al., 2013**). Also, **Cheng et al., 2014**reported that no relation between serum 25(OH) D levels and AR.

Conclusion

The level of vitamin D_3 was found to be low in patients of AR.

Also vitamin D_3 deficiency influences the severity of symptoms. Supplementation of vitamin D in such patients may improve quality of life. So, more studies are wanted to evaluate the effect of vitamin therapy in treatment of allergic rhinitis.

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