Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2013; 1(2): 138-141 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2013.v01i02.022
Received: 17-03-2013, Accepted: 25-04-2013, Published: 01-05-2013

Research Article

Serum Vitamin D Status and Clinical Profile of Pediatric Alopecia Areata: A Cross-Sectional Study

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Abstract: ***Background:*** Alopecia areata (AA) is a common autoimmune disorder characterized by non-scarring hair loss. Emerging evidence suggests that vitamin D may play an important role in immune regulation and hair follicle cycling. Deficiency of vitamin D has been proposed as a potential contributor to the pathogenesis and severity of alopecia areata. Studies in pediatric alopecia areata have reported associations between lower vitamin D levels and greater disease severity. ***Objective:*** To evaluate serum vitamin D status and clinical characteristics among pediatric patients with alopecia areata and determine the association between vitamin D levels and disease severity. ***Methods:*** A cross-sectional study was conducted among 180 pediatric patients diagnosed with alopecia areata. Clinical characteristics, disease duration, pattern of hair loss, nail involvement, family history, and laboratory findings including serum 25-hydroxyvitamin D levels were analyzed. Disease severity was assessed using the Severity of Alopecia Tool (SALT) score. ***Results:*** Vitamin D deficiency was identified in 94 (52.2%) patients. Children with moderate-to-severe alopecia areata demonstrated significantly lower vitamin D levels than those with mild disease. Nail involvement, extensive scalp involvement, and longer disease duration were more common among vitamin D-deficient patients. Multivariate analysis identified vitamin D deficiency, disease duration greater than six months, and nail involvement as independent predictors of severe alopecia areata. ***Conclusion:*** Vitamin D deficiency is common among pediatric patients with alopecia areata and is associated with increased disease severity. Assessment of vitamin D status may provide additional information regarding disease burden and help identify children requiring closer monitoring. Studies in pediatric populations suggest lower vitamin D levels may be linked to more extensive disease.
Keywords: Alopecia areata, Vitamin D deficiency, Pediatric dermatology, Autoimmune disease, Hair loss, SALT score.

INTRODUCTION

Alopecia areata (AA) is a chronic autoimmune disorder characterized by non-scarring hair loss involving the scalp and other hair-bearing areas of the body. The disease results from immune-mediated destruction of hair follicles, leading to disruption of normal hair growth. Although alopecia areata can occur at any age, a substantial proportion of cases develop during childhood and adolescence [1,2].

The prevalence of pediatric alopecia areata has increased in recent years, making it one of the most common causes of childhood hair loss encountered in dermatological practice. Clinical manifestations vary from isolated patchy hair loss to complete scalp involvement (alopecia totalis) or complete body hair loss (alopecia universalis). Childhood disease often carries a significant psychosocial burden and may adversely affect quality of life and emotional well-being [3].

The exact pathogenesis of alopecia areata remains incompletely understood. However, autoimmune mechanisms involving T-lymphocyte-mediated attack on hair follicles are widely accepted as central to disease development. Genetic susceptibility, environmental triggers, and immunological dysregulation contribute to disease onset and progression [4,5].

Vitamin D has emerged as an important regulator of immune function and cellular differentiation. Beyond its role in calcium homeostasis and bone metabolism, vitamin D exerts significant immunomodulatory effects through vitamin D receptors expressed on various immune cells. Vitamin D receptors are also present within hair follicles, suggesting a potential role in hair follicle cycling and maintenance [6].

Several studies have demonstrated lower serum vitamin D concentrations among patients with alopecia areata compared with healthy controls. Furthermore, reduced vitamin D levels have been associated with increased

disease severity and longer disease duration in some pediatric studies. However, findings remain inconsistent and additional research is required to clarify this relationship. Pediatric studies have reported that lower vitamin D levels may correlate with more severe forms of alopecia areata.

Early identification of modifiable factors associated with disease severity may improve clinical management and patient outcomes. Therefore, the present study aimed to evaluate serum vitamin D status and clinical characteristics among pediatric patients with alopecia areata and determine factors associated with severe disease.

METHODOLOGY

A hospital-based cross-sectional study was conducted in the Department of Dermatology of a tertiary care teaching hospital. Institutional ethical approval was obtained before initiation of the study.

Children aged less than 18 years with clinically diagnosed alopecia areata were included. Diagnosis was established based on clinical examination by experienced dermatologists. Patients receiving vitamin D supplementation, systemic immunosuppressive therapy, or having chronic systemic illnesses affecting vitamin D metabolism were excluded.

Clinical data collected included age, sex, disease duration, age at onset, pattern of alopecia, family history of autoimmune disease, nail involvement, and SALT score. Disease severity was categorized as mild (SALT <25%), moderate (SALT 25–50%), and severe (SALT >50%).

Blood samples were collected after overnight fasting. Serum 25-hydroxyvitamin D levels were measured using chemiluminescent immunoassay. Vitamin D status was classified as deficiency (<20 ng/mL), insufficiency (20–30 ng/mL), and sufficiency (>30 ng/mL).

Statistical analysis was performed using SPSS version 22. Continuous variables were expressed as mean ± standard deviation while categorical variables were expressed as frequencies and percentages. Student's t-test, Chi-square test, and logistic regression analyses were performed. Statistical significance was defined as $p<0.05$.

RESULTS

Table 1. Baseline Characteristics of Pediatric Alopecia Areata Patients (n=180)

Variable	Value
Mean Age (Years)	11.8 ± 3.7
Male	102 (56.7%)
Female	78 (43.3%)
Mean Disease Duration (Months)	8.6 ± 4.9
Positive Family History	38 (21.1%)
Nail Involvement	42 (23.3%)
Mean SALT Score	27.6 ± 18.4

The study population consisted predominantly of school-aged children. Approximately one-fifth reported a positive family history, while nail involvement was observed in nearly one-quarter of patients.

Pediatric alopecia areata demonstrated a slight male predominance. Family history and nail changes were relatively common findings, supporting the autoimmune and genetic components of disease pathogenesis. The mean SALT score indicated moderate overall disease burden within the study population.

Table 2. Vitamin D Status Among Pediatric Alopecia Areata Patients

Vitamin D Status	Frequency (%)
Deficient (<20 ng/mL)	94 (52.2%)
Insufficient (20–30 ng/mL)	48 (26.7%)
Sufficient (>30 ng/mL)	38 (21.1%)
Total	**180 (100.0%)**

More than half of the participants demonstrated vitamin D deficiency, while only one-fifth had sufficient vitamin D levels.

Vitamin D deficiency was highly prevalent among pediatric patients with alopecia areata. The findings suggest that hypovitaminosis D may be a common comorbidity in children with autoimmune hair disorders. Similar observations have been reported in pediatric alopecia areata studies.

Table 3. Relationship Between Disease Severity and Vitamin D Levels

Variable	Mild AA	Moderate AA	Severe AA	p-value
Vitamin D (ng/mL)	29.6 ± 8.4	22.8 ± 7.6	16.9 ± 6.2	<0.001
Nail Involvement (%)	10.8	25.0	46.9	<0.001
Disease Duration > 6 Months (%)	31.1	54.2	78.1	<0.001
Positive Family History (%)	15.5	20.8	34.4	0.042

Vitamin D levels progressively declined with increasing disease severity. Severe alopecia areata was associated with greater nail involvement and longer disease duration.

Children with severe disease demonstrated significantly lower serum vitamin D levels than those with mild disease. The presence of nail changes and prolonged disease duration further reflected greater disease burden and chronicity.

Table 4. Independent Predictors of Severe Alopecia Areata

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Vitamin D Deficiency	3.84	1.92–7.68	<0.001
Disease Duration > 6 Months	3.17	1.58–6.37	0.001
Nail Involvement	2.91	1.38–6.12	0.005
Family History	1.96	0.92–4.18	0.081
Female Gender	1.24	0.61–2.53	0.542

Vitamin D deficiency emerged as the strongest independent predictor of severe disease. The regression analysis demonstrated a significant relationship between vitamin D deficiency and severe alopecia areata. Disease chronicity and nail involvement also independently contributed to disease severity, emphasizing their clinical significance during patient assessment.

DISCUSSION

The present study demonstrated a high prevalence of vitamin D deficiency among pediatric patients with alopecia areata. More than half of the study population exhibited deficient vitamin D levels, supporting previous observations suggesting an association between vitamin D status and autoimmune hair disorders.

Alopecia areata is widely recognized as a T-cell-mediated autoimmune disease targeting anagen hair follicles. Vitamin D possesses important immunomodulatory properties and influences T-cell activity, cytokine production, and immune tolerance. These mechanisms provide biological plausibility for a relationship between vitamin D deficiency and alopecia areata severity [6,7].

The most important finding of this study was the significant association between vitamin D deficiency and disease severity. Children with severe alopecia areata demonstrated markedly lower vitamin D levels than those with mild disease. Similar findings have been reported in pediatric studies showing that lower vitamin D levels correlate with more extensive scalp involvement and longer disease duration.

Vitamin D receptors are strongly expressed within hair follicles and play a critical role in maintaining normal follicular growth and differentiation. Experimental studies have demonstrated that absence of vitamin D receptor activity may result in impaired hair follicle cycling and abnormal hair growth [8].

Nail involvement was significantly associated with severe disease in the present study. Previous investigations have identified nail abnormalities as markers of extensive alopecia areata and poor prognosis. The relationship observed in this study further supports the role of nail involvement as an indicator of severe autoimmune activity [9].

Disease duration greater than six months emerged as another independent predictor of severe alopecia areata. Chronic inflammatory activity may contribute to progressive follicular damage and reduced spontaneous recovery. Similar associations between prolonged disease duration and poor outcomes have been reported in pediatric populations [10].

Although family history demonstrated a trend toward increased severity, statistical significance was not maintained after multivariate adjustment. Nevertheless, genetic predisposition remains an important factor in alopecia areata pathogenesis and has been consistently reported in previous studies [11].

The findings of this study suggest that vitamin D assessment may provide useful prognostic information in pediatric alopecia areata. Whether vitamin D supplementation improves disease outcomes remains uncertain and requires further prospective investigation. Some studies have suggested potential benefits, while others have reported inconsistent results.

CONCLUSION

Vitamin D deficiency is highly prevalent among pediatric patients with alopecia areata and is significantly associated with increased disease severity.

Lower vitamin D levels, prolonged disease duration, and nail involvement were identified as important predictors of severe alopecia areata. Routine assessment of vitamin D status may aid clinical evaluation and risk stratification of pediatric patients with alopecia areata. Further prospective studies are required to determine whether correction of vitamin D deficiency can improve clinical outcomes.

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