

Trace Elements Levels in Serum and Hair of Patients with Vitiligo and Alopecia Areata

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Abstract

Background: Vitiligo is the most prevalent pigmentary disorder which occurs worldwide. The etiopathogenesis of vitiligo is complex, and includes genetic factors, autoimmune process, and infectious factors. Alopecia areata is a recurrent, nonscarring type of hair loss considered to be an autoimmune process. Though its etiopathology is not fully understood, there are claims that imbalance of trace elements may trigger the onset of alopecia areata.

Objectives: The objective of this study was to evaluate the levels of zinc, copper and magnesium in serum and hair of vitiligo and alopecia areata patients hopefully to gain a better understanding of the role of these trace elements in both diseases.

Methods: Twenty alopecia areata patients, twenty vitiligo patients, and twenty age and sex matched controls were studied. Samples were analyzed using atomic absorption spectrophotometric methods.

Results: Serum and hair zinc levels were significantly decreased in alopecia areata patients and also in vitiligo patients compared with controls. Serum and hair levels of copper and magnesium showed insignificant rise in both diseases when compared with controls.

Conclusions: Copper and magnesium levels are not altered in alopecia areata or vitiligo, but decreased zinc levels may play an important role in the etiopathogenesis of both diseases.

Keywords: Trace elements, serum, hair, alopecia areata, vitiligo.

الخلاصة

الخلفية: داء البهاق يعتبر من اكثر الامراض التصبغية شيوعاً على المستوى العالمي. مسببات نشوء المرض هي متعددة وتشمل: العوامل الوراثية، اختلالات المناعة الذاتية، والعوامل المعدية. داء الثعلب هو احد انواع فقدان الشعر غير الندبي المتكرر ويعتبر من اختلالات المناعة الذاتية. بالرغم من ان مسببات نشوء المرض غير مفهومة بصورة كاملة، الا ان البعض يعتقد ان عدم توازن العناصر الضئيلة قد تؤدي الى نشوء المرض.

الهدف من الدراسة: الهدف من الدراسة هو تقييم مستويات الزنك، النحاس والمغنيسيوم في مصل دم وشعر المرضى المصابين بداء البهاق وداء الثعلب على امل الحصول على فهم احسن لدور هذه العناصر الضئيلة في كلا المرضين.

الطرائق: الدراسة شملت عشرين مريضاً مصاباً بداء البهاق، عشرين مريضاً مصاباً بداء الثعلب وعشرين من الاشخاص الاصحاء بمختلف الاعمار ومن كلا الجنسين كمجموعة سيطرة. النماذج تم قياسها بطريقة الامتصاص الذري الطيفي.

النتائج: مستويات الزنك في مصل دم وشعر المرضى المصابين بداء البهاق وداء الثعلب وجدت ذات قيمة احصائية قليلة مقارنة بمجموعة السيطرة. مستويات النحاس والمغنيسيوم في مصل الدم والشعر اظهرت ارتفاعاً بدون قيمة احصائية مقارنة بمجموعة السيطرة في كلا المرضين.

الاستنتاجات: مستويات النحاس والمغنيسيوم لم تتغير في مرضى داء البهاق او داء الثعلب ولكن هبوط مستويات الزنك قد تلعب دوراً مهماً في نشوء مسببات المرضين.

Introduction

Vitiligo is a non contagious acquired pigmentation disorder characterized by sharply-defined white patches of variable shape and dimensions, increasing in size and number with time⁽¹⁾. The histological picture shows loss of melanocytes and melanin in the white patches and an inconstant lympho-mononuclear infiltrate in the advancing margins of vitiligo⁽¹⁾. It occurs worldwide, with an incidence rate between 0.1-2%^(2, 3), irrespective of age, race^(2, 4), ethnic origin, or skin color⁽⁵⁾. The etiopathogenesis of vitiligo is complex, and includes genetic factors, autoimmune process, infectious factors, and psychological factors (stress and personality characteristics of patients)⁽⁶⁾. Zinc is one of the important trace elements related to health and disease⁽⁷⁾. Zinc in combination with other micronutrients such as copper, cobalt, nickel, iron, manganese and calcium⁽⁸⁾ plays an important role in the process of melanogenesis^(8,9).

Alopecia areata (AA) is a recurrent, nonscarring type of hair loss that can affect any hair bearing area. The incidence of AA is 1-2% of population. The pathophysiology of AA is considered to be T-cell mediated autoimmunity that occurs mostly in genetically predisposed individuals⁽¹⁰⁾. In addition to disturbance of immune function, complex interactions between predisposing genetic and environmental factors act as triggers for disease progression⁽¹¹⁾. Also, perifollicular nerves and vasculature, viruses, trace element alterations⁽¹²⁾, endocrine disorders, and thyroid dysfunction⁽¹³⁾ have been hypothesized. There are claims that imbalance of trace elements may trigger the onset of AA. The objective of this study was to evaluate the levels of zinc, copper

and magnesium in serum and hair of vitiligo and AA patients and compare them with healthy people (controls).

Material and Method

The study was conducted in the departments of dermatology, Al-Kadhymia Teaching Hospital, and Chemistry and Biochemistry, College of Medicine/ Al-Nahrain University. The study group consisted of 20 cases of vitiligo and 20 cases of alopecia areata. Twenty age and sex matched healthy subjects were included as controls. Patients who had taken systemic or topical treatment within three months before the present study were excluded.

Five milliliters of venous blood were collected in plane tubes without anticoagulant, let to clot at room temperature then centrifuged at 3000 rpm for five minutes. The serum obtained was divided in proper aliquots and then kept frozen at -20°C until used for analysis. While the hair samples of the same patients and controls were taken from the back of the head (approximately 0.1g) and kept in plane tubes until preparation for analysis.

Zinc, Copper and Magnesium-analysis:

Preparation of hair samples was done by digesting 0.1 g of the samples (which were cut into very small pieces) with 15ml of conc. HNO₃, heating gently until the samples are completely dissolved. Samples of serum (diluted 1:10) with distilled water and hair samples (diluted 1:20) with distilled water were analyzed for zinc and copper with atomic absorption spectrophotometer. For magnesium analysis, serum (diluted 1:50) with LaCl₃ and hair samples (diluted 1:20) with LaCl₃. The samples were run with

their corresponding standards and obtained from their standard curve.

Statistical analysis:

All data were given as mean \pm standard deviation (SD). The Microsoft Office Excel program (version 2007) was used for statistical analysis. Students' *t*' was applied for data analysis. The *P* value of <0.05 was considered to be statistically significant.

Results

The study included 20 patients with vitiligo (10 women and 10 men) age of those patients ranged from 14 to 50

years (mean age=32.27 years), 20 patients with alopecia areata (9 women and 11 men) age of those patients ranged from 11 to 49 years (mean age=28.37 years), and 20 controls whose ages were between 11-49 years (mean age=28.37 years). This study shows that serum zinc levels are significantly lower than control in both diseases, while the mean values of copper in AA are insignificantly higher than controls but unchanged in vitiligo patients.

Magnesium levels were insignificantly higher than control levels in both diseases. The results are shown in table (1).

Table 1: Mean concentration of trace elements (Zn, Cu and Mg) in serum of alopecia areata patients, vitiligo patients and controls.

Trace elements	Mean \pm SD of controls	Mean \pm SD of AA patients	P - value	Mean \pm SD of vitiligo patients	P - value
Zinc ($\mu\text{g/dL}$)	59.37 \pm 6.95	31.69 \pm 8.65	$P < 0.05$	40.16 \pm 6.52	$P < 0.05$
Copper ($\mu\text{g/dL}$)	94.66 \pm 7.07	103.55 \pm 19.64	$P > 0.05$	94.35 \pm 4.84	$P > 0.05$
Magnesium (mg/dL)	3.87 \pm 0.49	3.99 \pm 0.23	$P > 0.05$	4.16 \pm 0.09	$P > 0.05$

Table 2: Mean concentration of trace elements (Zn, Cu and Mg) in hair of alopecia areata patients, vitiligo patients and controls.

Trace elements	Mean \pm SD of controls	Mean \pm SD of AA patients	P - value	Mean \pm SD of vitiligo patients	P - value
Zinc ($\mu\text{g/g}$)	65.02 \pm 14.64	52.5 \pm 6.58	$P < 0.05$	48.3 \pm 0.31	$P < 0.05$
Copper ($\mu\text{g/g}$)	21.07 \pm 0.40	21.3 \pm 0.10	$P > 0.05$	21.35 \pm 0.36	$P > 0.05$
Magnesium ($\mu\text{g/g}$)	42.04 \pm 5.31	59.14 \pm 29.20	$P > 0.05$	44.71 \pm 0.95	$P > 0.05$

Levels of zinc in the hair of AA and vitiligo patients were significantly lower than those of controls, while hair levels of copper and magnesium were insignificantly higher than controls in both diseases. See table (2).

Discussion

A number of studies have been made to reveal the effect of trace elements on different dermatological diseases. Bhat YJ *et al.* showed significant decrease in serum zinc levels in AA patients

whereas serum copper and magnesium levels showed insignificant rise compared to controls⁽¹⁴⁾, which support the results obtained from our study for the serum levels of the AA patients. Bruske and Salfeld interpreted the statistical association of blood and serum levels of zinc, magnesium, and copper in patients with many dermatological disorders including AA and after comparing with healthy people did not find any change in serum levels of zinc and copper, but found significantly higher level of magnesium⁽¹⁵⁾.

Mohamed M. *et al.* conducted a study to estimate copper and zinc levels in serum and skin of vitiligo patients; they found a significant reduction in serum zinc, while the results of copper analysis in vitiligo neither support a deficiency role for copper nor justify its use in the treatment of that disease⁽¹⁶⁾. This also supports our study for vitiligo patients. Tasaki M. *et al.* studied the serum levels of copper and zinc in different dermatological diseases including AA; they found that serum zinc levels were significantly decreased in some of these diseases among them is AA⁽¹⁷⁾. Using hair to assess essential elements is more controversial, yet researchers have found many correlations of essential elements to diseases, metabolic disorders, environmental exposures, and nutritional status^(18, 19). Compared to other types of clinical specimens, hair has different uses and even advantages over blood or urine, while urine and blood tend to show current or recent body status, hair represents a longer time frame, potentially years. Elements also occur in hair at high levels, allowing for more sensitive and, because of higher levels, more analytically accurate results. Mussalorauhama H. *et al.* studied different trace elements in serum and hair of alopecia patients; some elements were significantly different while others were not altered⁽¹²⁾. The varied results of the levels of magnesium, copper, and zinc in various studies can be explained on the basis of sample size, methodology, and population variation. The present study showed significantly low levels of zinc in serum and hair of patients with vitiligo and AA compared to control group. As cofactors of metalloenzymes, zinc has considerable effects on nearly all aspects of the metabolism that takes place in the organs of the body, including the skin. So, zinc deficiency

induced by trace element replacements with heavy metals can cause the onset of AA besides other factors⁽¹²⁾. Vitiligo is an acquired depigmenting disorder due to loss of melanocytes⁽²⁰⁾, and zinc in combination with other micronutrients such as copper, cobalt nickel, iron, manganese, and calcium⁽⁸⁾ plays an important role in the process of melanogenesis^(8, 9). They catalyze the rearrangement of dopachrome to form 5, 6-dihydroxy indole-2-carboxylic acid (DICA)^(8, 9), and enhancement of eumelanin polymer formation from monomers⁽⁸⁾. This process is the final stage of eumelanin formation in melanogenesis⁽⁸⁾ so zinc may have an important effect on vitiligo. The levels of copper and magnesium were not found to be significantly effective in either vitiligo or AA patients because their levels were not very much altered in serum or hair of these patients when compared to controls.

Further investigation taking larger number of patients and also dividing them into further classifications of these diseases to obtain better knowledge of the effect of these trace elements is needed. Also, treatment with zinc supplements can be tried in these patients to see the outcome.

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