

Significance of Serum Copper Levels in Patients with Acne Vulgaris

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Abstract

Introduction

Acne is one of the most common skin disorders. It is a disorder of pilosebaceous unit, commonly seen in adolescents and young adults [1,2]. Most cases of acne present with a pleomorphic lesions consisting of papules, macules comedones and nodules. Although the course of acne may be self-limiting the sequelae can be life-long with pitted or hypertrophic scar formation [3]. It is a syndrome in which neither exogenous agents nor medications are primary causes but they are exacerbating factors [4]. One of the key features is the excess sebum production from the sebaceous glands. While there is virtually no mortality associated with this disease, there is often significant morbidity seen. Physical morbidity of acne results from scarring and due to adverse effects of treatment. Also important is the psychological morbidity of the disease on those afflicted, which affects self-esteem and quality of life. The burden of acne in terms of cost to society is not well defined, but the prevalence of the disease suggests that these costs are high.

Copper deficiency promotes conversion of testosterone to dihydrotestosterone that promotes production of sebum [5]. Copper, through its involvement in the formation of several key enzymes is not only involved in the release of energy inside the cell, but also contributes to the function of very many antioxidants, assisting the "mopping up" of the free radicals that cause cell damage [6]. The formation and regulation of hormones such as melatonin is under the control of copper, via its role in the blood protein ceruloplasmin and copper enzymes are also responsible for the production of a wide range of neurotransmitters and other neuroactive compounds, including the catecholamines and encephalins. Thankfully, copper deficiency per se is rare but due to the intricate interaction with zinc (copper and zinc compete for the same absorption sites in the gut), high zinc levels can prevent proper absorption [7].

It has been suggested that nutritional factors such as vitamins and minerals are involved in the pathogenesis of acne [8,9]. The effect of copper on inflammatory cells and granulocytes is the most important mechanism related to acne [10]. Copper influences anti-inflammatory and pro-inflammatory enzymes, for example desaturases or lipoxygenases [11]. Superoxide dismutase (Cu-metalloenzyme) protects human skin cell from peroxidative damage, as human keratinocytes contain high concentrations of polyunsaturated fatty acids and also possess a significant ability to generate a Reactive Oxygen Species (ROS), mainly superoxide anion and hydrogen

peroxide [12]. The acne like lesions in copper deficiency has led investigators to assess the relationship between the serum copper levels and acne [2-5].

Copper has been predicted to be one of the root causes for acne and it is still evaluated if supplementation of diet with copper can lead to prevention and cure of acne [13-15]. However, there is only one report available on serum copper levels in acne patients from India [16]. Acne vulgaris is one of the common skin diseases in young individuals all over India and it has a lot of social and psychological impact on the individual's behavior and performance in his/her daily life. Therefore, we investigated serum copper levels in young patients with acne vulgaris who were doing their high school or college studies.

Materials and Methods

Young female patients in the age group of 13 to 19 years, with acne attending the out-patient department of Dermatology of a tertiary teaching general hospital, in India during the period from January 2017 to June 2017, were included in this study. Female attenders (friends) of the patients of the same age, without acne comprised of the control group. This study was carried out in 50 acne patients who were labeled as group 1. Normal controls were 25 in number without acne and they were labeled as group 2. The patients were explained about the purpose of the research project and informed consent was taken. This project was approved by ethical committee of the Gandhi Medical College/Hospital, Hyderabad, India.

Acne vulgaris at grade IV was diagnosed by comedones, papules, pustules, nodules and cysts on the surface of the skin resulting in inflammation within the dermis brought on by acne [17]. It was further differential diagnosed from Keratosis pilaris, rosacea, and chloracne which exhibit similar symptoms [18]. Selected patients had regular menstrual history and blood samples were collected when the subjects were not menstruating.

Every student was tested for hemoglobin level by using finger prick test and was excluded from the study if the hemoglobin was less than 10 g/dl, because copper deficiency can manifest as anemia which may further lower serum copper values [19]. All the patients and control subjects were advised overnight fasting. The blood samples of patients and controls were collected on the scheduled date and analyzed for copper levels at National Institute of Nutrition, Hyderabad by Atomic absorption spectrometry (SVL Spectronics, India). The mean values of serum copper inpatients group and control group were tested for statistical significance by using independent sample "t" test. The

Pvalue <0.01 was considered as significant.

Results

Table 1 portrays the mean serum Copper levels in patients ($119 \pm 1.99 \mu\text{g/dl}$) which was significantly lower than those in controls ($131.2 \pm 0.93 \mu\text{g/dl}$), ($P < 0.001$). The observation is that the mean copper values are lower in acne patients which is statistically significant ($p < 0.001$) as compared to control

Discussion

Saleh et al. estimated serum zinc, copper and magnesium levels in 45 Iraqi patients with acne vulgaris and 45 healthy controls, and reported that serum levels of copper did not differ in severe acne group compared with controls, mild and moderate groups of acne patients ($P < 0.05$) [20]. The results of El-Saaie et al. revealed differences in the copper and iron content of the sera between 30 individuals complaining of moderate acne vulgaris type II and healthy individuals, although they were statistically not significant [21].

Sherman et al. estimated serum copper levels in 73 Iraqi individuals with acne vulgaris and in 42 healthy individuals as a control group [22]. The study revealed that there was increase in the level of copper in the patients in comparison with the control group. Using estrogen releasing birth control or a copper intra uterine device (IUD) can lead to copper toxicity. When more estrogen is released into the body, it can increase copper retention in the kidneys. Excess copper then builds up in the liver, preventing the liver from detoxifying the blood properly. This can then lead to poor mineral absorption and toxins into the blood stream and of one of the outcomes is chronic acne. In addition, copper levels rise in response to stress. The results of our present study shows that the mean of serum copper of patients and controls were within the reference ranges and that the patients had lower serum copper than control. Thus acne patients showed a decrease in copper levels. Other contributing factors for the occurrence of acne in the patients enrolled in our study could either be due to stress among the adolescent girls or due to sudden upsurge of estrogen at the onset of puberty.

Our study revealed a statistical decrease in serum copper levels in acne patients which is in conformity with many previous works who reported low serum levels of copper with the incident of acne. Hence, it is hereby recommended that various treatments of patients with inflammatory acne may be adopted in the prevention and cure of acne [23]. Parsons used para-acetophenetidin copper for the treatment of acne with success [24].

Many young women notice that acne is worse before their menstrual period. This may be because there is a relationship between acne and copper imbalance. Copper, along with estrogen and progesterone, tends to rise before the menstrual period. When copper is balanced in the

body, acne goes away. Copper imbalance is also the cause of premenstrual syndrome and symptoms such as anger, anxiety, depression, moodiness, breast tenderness and swelling and other symptoms that occur around the menstrual period. To balance copper in the body, one must improve the diet and take several nutritional supplements containing about 1-2 mg of copper. Root cause of acne in addition to copper and other nutritional factors could either be due to stress among the adolescent girls or due to sudden upsurge of estrogen at the onset of puberty [25].

Conclusion

From the present study we postulate that serum copper levels are considerably at lower levels in acne vulgaris patients when compared to controls in addition to a stressful condition among the adolescent girls. Thus, looking into our results and previous research data from the literature it is advisable to have adjunctive copper therapy (in the form of oral medication as well as in the daily diet) for prevention and management of patients with acne.

Reference

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