

Review Article

Hair - a mirror of diabetes

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Abstract Diabetes mellitus affects virtually all organs of the body including skin and its appendages. Hair can provide lot of information about the disease activity. The present review focuses on the hair changes in diabetes and its role in the control of disease.

Key words

Diabetes mellitus, hair, glycosylated hemoglobin.

Introduction

It has been estimated that the scalp of a healthy adult contains an average of 80,000-120,000 hairs. The normal cycle of hair growth lasts for 2 to 6 years. Human scalp hair normally grows at a rate of 0.4 mm/day or 1 centimeter (less than half an inch) per month. About 90 percent of the hairs on scalp are in anagen or growing phase, at any one time. About 10 percent of the hairs on scalp are in a resting phase or catagen phase. After 2 to 3 months, the resting hairs enter into the telogen phase and these hairs fall, after which new hairs start growing in its place.

Effects of diabetes on hair

Diabetes is a life long illness that acts like a termite. It involves each and every organ of the body. In the past, many organs, except hair were considered to mirror the complications of diabetes. Study of molecular of hair has opened new vistas in the diagnosis of diabetes and its complications.

Determining the time of onset of diabetes by the levels of glycosylated keratin in hair

The only tool to measure long term serum glucose regulation is Hb_{A1c}. The life of a red blood cell is 120 days. Glucose molecules join hemoglobin, forming glycated hemoglobin. The glycated hemoglobin within the red cell reflects the average level of glucose to which the cell has been exposed during its life. The Hb_{A1c} level is proportional to average blood glucose concentration over the previous four weeks to three months.

Hair proteins are also glycated as blood flows through the hair follicles and glycosylation is increased in instance of diabetics. Assays of glucose and proteic sulphur levels in the hair of diabetic patients provide information on the preclinical stage of hyperglycemic disorders.

Many studies have been conducted to assess the variations of glucose in hair with the comparison of Hb_{A1c}. All have proved that there is significant correlation between glycosylation of the proximal 4 cm of hair and the glycosylated hemoglobin. The length of hair of 4 cm represents a period of roughly 16 weeks at an assumed average rate of hair growth of 0.37 mm/day. In contrast, the closest correlations of glycosylated hemoglobin values have been with

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mean blood glucose concentrations in the preceding eight to 12 weeks. In this way, one can follow up the diabetic's metabolic balance on longer time periods than by determination of the Hb_{A1c} values.

An important factor when evaluating hair glycosylation is that it remains stable along the length of the hair from scalp to tip. This suggests that a sufficiently long hair sample may provide a long term record of degree of hyperglycemia. Hair samples of 12 cm long, corresponding roughly to 1 year's tissue glycosylation and diabetic microvascular complications. Such investigations in subjects at high risk of developing diabetes might reveal the period preceding the disease onset, thus enabling to start an early therapy. This offers a relatively new method of long term retrospective evaluation of metabolic balance in diabetes.

Therefore, the hair of a person may represent an easily accessible and non-invasive tissue for the study of hyperglycaemia which leads to diabetic complications.

Hair loss: first sign of diabetes

Significant rate of hair loss may alert an individual to the possibility of the development of diabetes. If an individual is losing hair in larger than normal quantities, and the loss does not appear to follow common pattern of hair loss, evaluation by a doctor is required. Uncontrolled diabetes can cause diffuse hair loss. Only a few diabetologists recognize this as a first sign of diabetes.

Different mechanisms can explain hair loss in diabetes:

1. Diabetes causes poor blood circulation which can affect the ability of hair

follicles to operate normally. The follicle does not produce a new strand or filament; the old strand dies and falls, and there is no replacement for the fallen hairs, gradually changing the affected person's scalp with thinner and sparsely located hairs.

2. The drugs used for diabetes can interrupt the normal cycle of hair growth. More often, this is reversed as the body adjusts to the medication later on.
3. Diabetes causes both physiological and psychological stress and anxiety. Stress and anxiety are direct factors in hair loss. Dehydration is a factor as well. When coupled with stress, it can be disastrous for the hairs.

A study of 6,00,000 people in France apparently unaware of the fact that they are suffering from type 2 diabetes complained of diffuse hair loss. All patients having complaint of hair loss should have their serum glucose level checked. Silent diabetes can even sometimes be diagnosed via unexplained hair loss.

Thinning of hair

Diabetics have thin hair as compared to normoglycemic population. Hair shaft diameter is significantly reduced in diabetics. A study was conducted by Klam⁵ in which morphological characteristics of samples of scalp hair from normal children and adolescents (8-17 years) and a comparison with a group of diabetic children (8-11 years) was done. In normal children, there was no sex difference. Significant increase in the diameters of both bulb and shaft were found when pre-pubertal (8-11 years) and pubertal (12-17 years) groups were compared. Diabetic female children had smaller bulb diameters and diabetics of both sexes had

reduced shaft diameters in comparison to normal children of similar age.

Deficiency of trace elements in hair

Skalnaya *et al.*⁶ studies trace elements of hair in 1470 women, aged 46-60 years, living mainly in Moscow city and Moscow region. There were three groups of women: obese, diabetic and practically healthy. The elemental status of occipital scalp hair was measured. The obesity in women corresponded to elevated hair K, Hg, Pb and decreased Ca, Mg, Zn, I. The type-2 diabetes had elevated hair K, Na, Hg and decreased Ca, Mg, Zn; the obtained data demonstrated the very similar changes in hair elemental content in both obese and diabetic women, thus suggesting the general pathophysiological mechanisms of metabolic mineral disturbances.

Zinc deficiency and normal contents of magnesium and calcium in metabolic X syndrome patients was also assessed by the analysis of hair element concentrations. These studies prove that deficiency of Zn is universal in diabetes,⁷ metabolic X syndrome and obesity.

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