

# Evaluation of selected parameters of oxidative stress in patients with androgenetic alopecia

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Androgenetic alopecia (AGA) is a type of non-pubescent baldness with progressive thinning of the head hair according to a characteristic pattern [1]. The pathogenesis of androgenetic alopecia includes both genetic and hormonal factors [2].

Some studies suggest that inflammation is the concomitant feature of AGA, although its importance in the pathogenesis of this disease is quite controversial [2, 3]. Activated T cells accumulating within the hair follicles have been observed in head skin biopsies in patients with AGA [4]. At the same time, moderate lymphocytes infiltration occurred in about 40% of cases of androgenetic alopecia and it was also present in 10% of healthy controls [5]. Occasionally, the presence of eosinophilia and mast cells could be observed [6]. Inflammation and oxidative stress are closely related in biological systems [2]. Oxidative stress in addition comes to accelerate the aging process as AGA deteriorates with age [7].

To date, Prie *et al.* have presented one of the few reports indicating a significantly higher plasma malondialdehyde (MDA) concentration in patients with AGA in relation to the control group [2]. The present state may be explained by the inconsistencies in the scientific community regarding the recognition of inflammation as a concomitant feature of AGA [2, 3]. Although histological studies have confirmed the presence of inflammation in the hair follicles, clinically AGA is still considered a non-inflammatory disease [8, 9].

Current medical literature provides little information on the oxidative stress parameters in the blood of patients with androgenetic alopecia, and therefore it was considered interesting to study the antioxidant systems in erythrocytes and plasma of these patients.

This study aims to investigate the role of oxidative stress in cases of AGA and in healthy controls by measuring the levels of plasma and erythrocyte (MDA) and the level of the ferric reducing ability of plasma (FRAP). The study included 21 AGA patients (12 females/9 males, mean age: 45.8 ±12) and the control group consisting of 40 age- and sex-matched healthy volunteers (25 females/15 males, mean age: 33.9 ±11). There was no significant body mass index (BMI) difference between the groups.

Malondialdehyde concentration in blood plasma was higher in patients with AGA compared with controls (4.55% and 14.29%, respectively), but these differences were not statistically significant ( $p = 0.572$ ;  $p = 0.132$ ). However, significant differences were observed in FRAP levels ( $p = 0.028$ ) between the studied group and the healthy volunteers. There was a positive correlation between plasma MDA levels and FRAP in patients with AGA ( $r_s = 0.457$ ;  $p = 0.037$ ) (Table 1).

Oxidative stress is a result of inadequate antioxidant defence or overproduction of reactive oxygen species (ROS). Its presence has been demonstrated in many dermatological diseases, including alopecia areata, psoriasis, vitiligo, atopic dermatitis, lichen planus, acne vulgaris, seborrheic dermatitis and skin cancer [10] as well as in androgenetic alopecia [2].

Lipid peroxidation is one of the most important biological processes associated with the action of ROS. Erythrocytes are particularly exposed to oxidative stress [11]. Increased levels of MDA in plasma and erythrocytes in patients with androgenetic alopecia suggest the occurrence of increased oxidative stress and may be associated with the presence of inflammation.

The FRAP evaluation allows the direct determination of the antioxidant capacity of cells and tissues as well as

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**Table 1.** The values of MDA and FRAP in peripheral blood of androgenetic alopecia patients and healthy subjects

Parameter	AGA patients n = 21 Me (Q25–Q75)	Healthy subjects n = 30 Me (Q25–Q75)	P-value
MDAe [nM/gHb]	22.22 (18.37–29.71)	19.35 (14.61–28.73)	0.130
MDA [nM/ml plasma]	0.44 (0.42–0.49)	0.42 (0.38–0.46)	0.572
FRAP [mmol/l]	212.00 (185.00–241.00)	184.00 (155.00–224.00)	0.028

AGA – androgenetic alopecia, Me – median, MDA<sub>e</sub> – malondialdehyde concentration in erythrocytes, MDA – malondialdehyde concentration in blood plasma, p – statistical significance level (Mann-Whitney U test).

the measurement of oxidative stress and its effects in the body. It provides the necessary information on the reduction power of body fluids [12].

Significant differences in the FRAP levels may result from the body defensive response to the ongoing process of lipid peroxidation. This hypothesis may be supported by a positive correlation between the FRAP level and plasma MDA concentration in patients with AGA.

Taking into account that the relationships between inflammation and oxidative stress are the subject of many studies, the interest in the oxidative-antioxidative balance in the course of AGA seems to be fully understood. This study was aimed at further explanation of the sources of oxidative damage and possible endogenous antioxidative mechanisms occurring in the course of this disease in humans.

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### Conflict of interest

The authors declare no conflict of interest.

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