

Oxygen metabolism in seborrhoeic dermatitis

EWA TRZNADEL-GRODZKA¹, ANNA KACZOROWSKA¹, HELENA ROTSZTEJN²

¹Department of Dermatology and Pediatrics Dermatology, Medical University of Lodz, Łódź, Poland

²Department of Cosmetology, Medical University of Lodz, Łódź, Poland

Abstract

Introduction: Etiopathogenesis of seborrhoeic dermatitis remains unclear. Genetic, hormonal, environmental, infectious and immunological factors have been proved to contribute to the development of this disease. The authors decided to evaluate selected indices of oxygen metabolism in the active phase of the disease.

Material and methods: Sixty subjects were included in the study. They were 30 patients (14 females and 16 males) with seborrhoeic dermatitis and 30 healthy volunteers (23 females and 7 males), who made up the control group. The level of nitric oxide (NO) and total antioxidant capacity (TAC) of plasma as well as activity of superoxide dismutase (ZnCu-SOD) and malonyl dialdehyde (MDA) in erythrocytes of whole blood were determined.

Results: The increased level of NO and the increased activity of superoxide dismutase were observed only in the males from the study group in comparison with the males from the control group. In the females the differences between the subjects from the study and control group were not statistically significant. Similarly, there were no differences in terms of the level of MDA in erythrocytes and total antioxidant capacity in plasma between both the male and female patients and the control group subjects.

Conclusions: Observed disturbances of some parameters of prooxidative and antioxidative balance in the patients in the active phase of the disease may imply that reactive oxygen species play a role in etiopathogenesis of seborrhoeic dermatitis.

Key words: seborrhoeic dermatitis, nitric oxide, malonyl dialdehyde, superoxide dismutase, total antioxidant capacity.

(Centr Eur J Immunol 2011; 36 (4): 248-253)

Introduction

Seborrhoeic dermatitis is a chronic dermatosis and it occurs frequently. The most intensive pathological lesions appear in the most exposed body areas – the skin of the head, face, décolleté and arms. The lesions often cover the whole body, taking the form of erythrodermia. The patients suffering from seborrhoeic dermatitis often feel stigmatized and the quality of their life is low. Genetic, hormonal, environmental, infectious and immunological factors are analyzed in the etiopathogenesis of seborrhoeic dermatitis. Clinical pathological lesions are of scaling and inflammatory nature. Besides, *Malassezia furfur* is often found in the lesions; however, the way in which this fungus penetrates the skin barrier is not completely known [1-3]. Cells (neutrophils, monocytes – macrophages) which are able to produce reactive oxygen species, superoxide anion-radical and nitric oxide, play the key role in the first unspecific pro-

tection of the skin as a barrier. Excessive, uncontrolled release of reactive oxygen species, when the protective mechanisms are not so effective, leads to disturbances in the balance maintenance system [4]. Literature data do not present any publications on the role of oxygen metabolism in etiopathogenesis of seborrhoeic dermatitis. The results of studies on the role of reactive oxygen species might turn out to be highly important when we want to determine the etiopathogenic factor, choose the method of treatment and prevent the disease from recurring.

The aim of the study is to evaluate selected parameters of oxygen metabolism and total antioxidant capacity in the patients with seborrhoeic dermatitis by determining: the level of nitric oxide (NO) in plasma, total antioxidant capacity (TAC) in plasma, activity of superoxide dismutase (ZnCu-SOD) in erythrocytes of whole blood, the level of malonyl dialdehyde (MDA) in erythrocytes of whole

Correspondence: Prof. Helena Rotsztejn, Department of Cosmetology, Medical University of Lodz, Muszynskiego 1, 90-151 Łódź, Poland, phone number +48 604 180 044, fax number +48 42 677 91 14, e-mail: helena.rotsztejn@umed.lodz.pl

blood and oxygen metabolism depending on the sex of the patient.

Material and methods

Sixty subjects were included in the study. The study group (S) consisted of 30 people (14 females and 16 males) aged 19-64 ($\bar{x} = 39.40 \pm 12.93$ years) with clinically diagnosed seborrhoeic dermatitis. The control group (C) consisted of 30 people (23 females and 7 males), clinically diagnosed as healthy, aged 24-65 ($= 37.41 \pm 6.08$ years). To determine the level of nitric oxide in plasma Bioxytech kit, Nitric Oxide Assay as well as Geiss reagents were used. Total antioxidant capacity in plasma expressed by mMol $FeCl_2 \cdot 4H_2O/l$ was determined with spectrophotometric method – FRAP (ferric reducing antioxidant power, i.e. the ability of plasma to reduce ferric ions Fe^{3+} to ferrous ions Fe^{2+}). The activity of ZnCu-SOD in erythrocytes was determined with the method invented by Misra and Fridovich and to determine the level of MDA in erythrocytes Placer method was used. For the purpose of a statistical analysis t-Student’s test for dependent and independent trials was used.

The statistical analysis of the obtained material was carried out in the particular groups in the following way:

- C : F vs. M
- S : F vs. M
- C vs. S : F
- C vs. S : M
- C vs. S

Total the subjects gave a written consent to participate in the study and the researchers were given a consent from the Bioethics Committee.

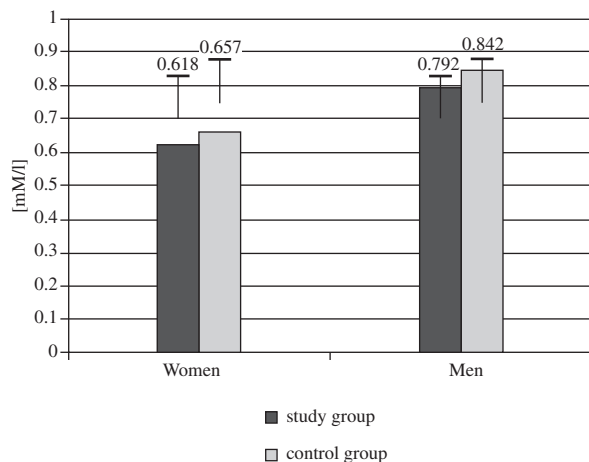


Fig. 2. Antioxidant potential (FRAP value) after 1 minute of the study in the patients with seborrhoeic dermatitis and in the control group (expressed in mM/l)

Results

Generation of NO in the patients from the study group was significantly higher in comparison with the control group (Fig. 1).

Total antioxidant capacity, determined with FRAP method after 1, 3, 5 and 10 min of the study in the subjects from the study and control group, was not statistically different (Figs. 2-7).

The activity of ZnCu-SOD in the group of patients with seborrhoeic dermatitis was higher in comparison with the activity of ZnCu-SOD in the control group; however, the difference was statistically significant only in the male group (Fig. 8).

The level of MDA was not different, neither between the study and control group, nor between the females and males (Fig. 9).

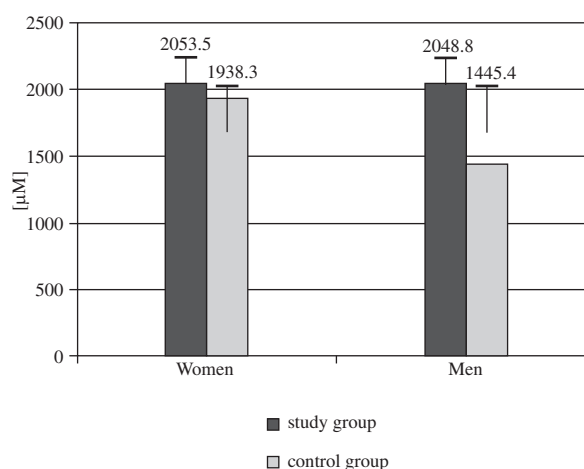


Fig. 1. Generation of nitric oxide (NO) in the patients with seborrhoeic dermatitis and in the control group (expressed in μM)

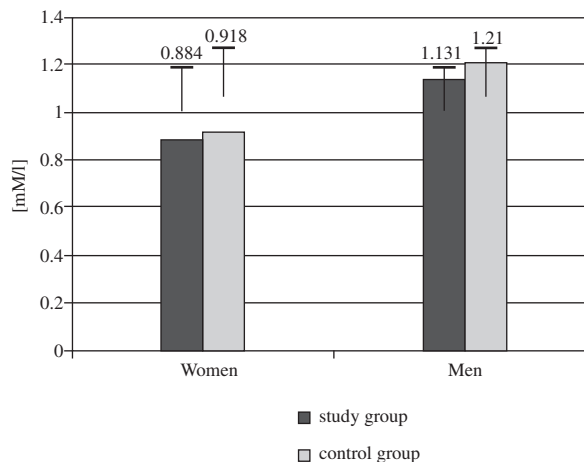


Fig. 3. Antioxidant potential (FRAP value) after 3 minutes of the study in the patients with seborrhoeic dermatitis and in the control group (expressed in mM/l)

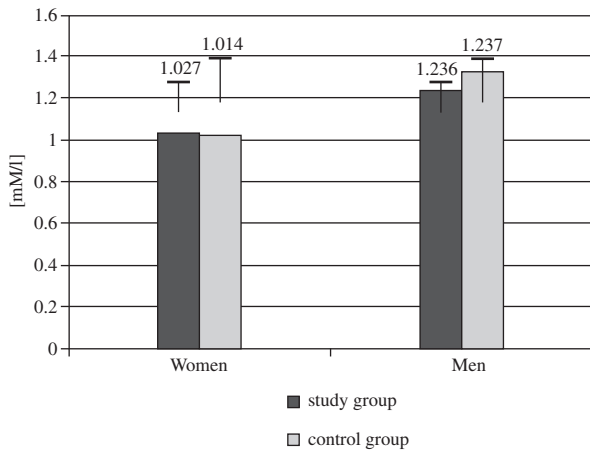


Fig. 4. Antioxidant potential (FRAP value) after 5 minutes of the study in the patients with seborrhoeic dermatitis and in the control group (expressed in mM/l)

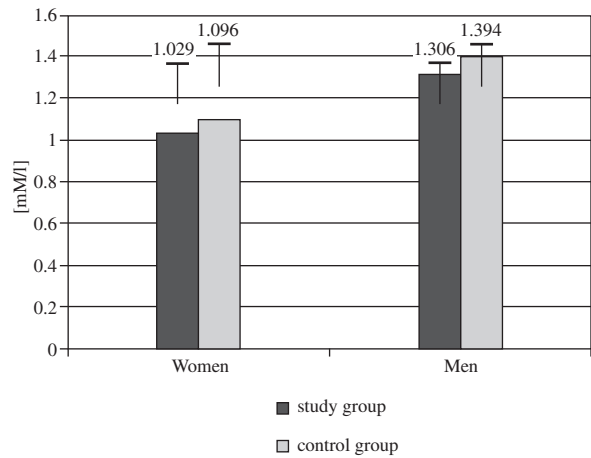


Fig. 5. Antioxidant potential (FRAP value) after 10 min of the study in the patients with seborrhoeic dermatitis and in the control group (expressed in mM/l)

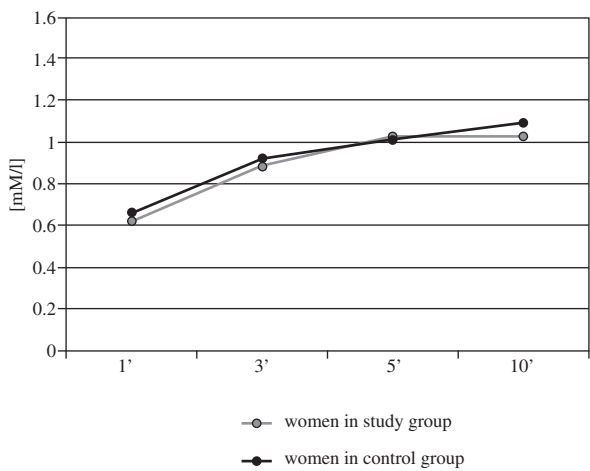


Fig. 6. Mean FRAP values after 1, 3, 5 and 10 minutes in the females from the study and control group (expressed in mM/l)

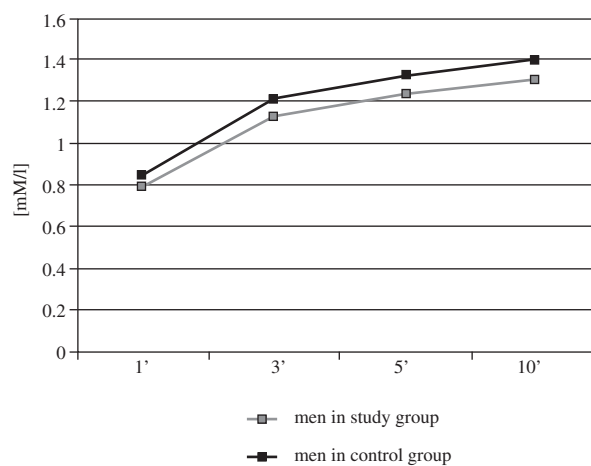


Fig. 7. Mean FRAP values after 1, 3, 5 and 10 minutes in the males from the study and control group (expressed in mM/l)

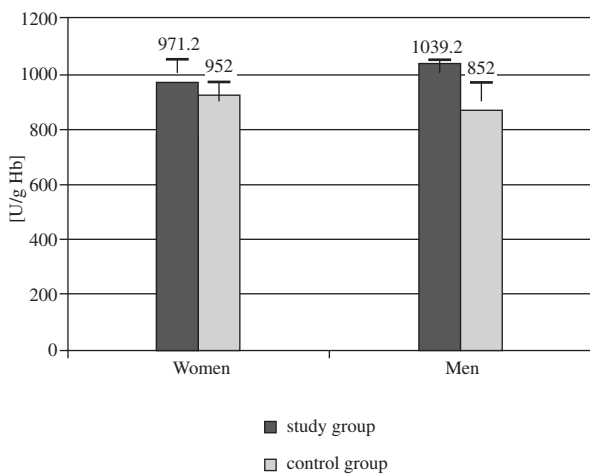


Fig. 8. The activity of superoxide dismutase (ZnCu-SOD) in erythrocytes in the group of patients with seborrhoeic dermatitis and in the control group (expressed in U/g Hb)

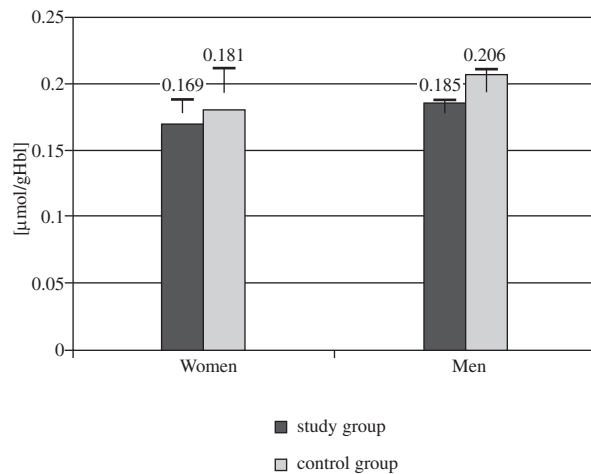


Fig. 9. The level of malonyl dialdehyde (MDA) in erythrocytes in the group of patients with seborrhoeic dermatitis and in the control group (expressed in $\mu\text{mol/gHb}$)

Discussion

Seborrhoeic dermatitis is a chronic, inflammatory dermatosis. Some immunological disturbances were proved to occur in the course of the disease, both in the plasma and skin. In literature data there is irrefutable evidence that *Malassezia furfur* contributes to initiating the inflammatory process [1, 2]. There are not, however, studies on the role of oxygen metabolism in initiating and developing the course of the disease. Therefore, the authors decided to make a pre-analysis of the following parameters: NO, TAC, ZnCu-SOD, and MDA.

Measurement of nitric oxide

In the course of psoriasis the amount of nitric oxide generated in plasma was increased [5-7]. The level was also significantly higher in chronic, inflammatory dermatosis such as in lichen planus [8, 9], alopecia areata [10] and in Behçet disease [11].

In our study on the concentration of nitric oxide in plasma in the patients with seborrhoeic dermatitis and in the healthy subjects, the most significant differences occurred in the male group. The statistically significant increased level of NO was observed in the male patients in comparison to the males in the control group. There were no statistically significant differences in the male and female patients. The results may be the proof for the increased "oxidative stress" in the patients, which in turn is accompanied by the increase in the production of reactive oxygen species and nitric oxide. It may be concluded that nitric oxide plays an important role in etiopathogenesis of seborrhoeic dermatitis.

Measurement of total antioxidant capacity

Although the activity of antioxidant enzymes in plasma is low in comparison with their intracellular activity, plasma, being easily available, is the most frequently analyzed fluid [12].

There are a few methods with which it is possible to determine the value of TAC. In some methods the degree of inhibition of oxidation by antioxidants present in the analyzed material is measured; some other methods include the determination of the reduction potential of the analyzed samples [13].

Ferric reducing antioxidant power is one of methods of measuring TAC. Here the ability of plasma to reduce ferric ions to ferrous ions is determined [12].

The results obtained with FRAP method refer exclusively to low molecular-weight antioxidants which directly neutralize free radicals. In the reaction they give electrons to free radicals and they become more stable radicals. The result became the grounds for making an assumption that the total reducing capacity of the biological samples reflects the total antioxidant capacity.

Firuzi *et al.* analyzed the total antioxidant capacity in skin diseases [14]. It was determined in 17 patients with systemic scleroderma, 10 with arthropatic psoriasis and 9 with rheumatoid arthritis. The results were then compared with the results obtained in the healthy subjects. The difference between the patients from three groups and the control group as for TAC was not statistically significant. In all cases the studies were conducted in small groups, which might have affected the results of the research.

Till now FRAP method has not been used to analyze the antioxidant potential of plasma in patients with seborrhoeic dermatitis.

In our study TAC of plasma was determined with the use of FRAP method after 1, 3, 5 and 10 minutes in the patients with seborrhoeic dermatitis and clinically diagnosed as healthy.

Having analyzed TAC after 1 and 3 minutes no statistically significant differences between the patients and healthy people were observed. However, the antioxidant capacity was decreased in the study group. There were differences also in the group of the healthy subjects. Higher values were observed in the males. Having analyzed TAC after 5 minutes it was concluded that the results are similar in both the groups. The results did not depend on the sex of the subjects. Similar results were obtained after 10 minutes of the study. The differences were not statistically significant. Ferric reducing antioxidant power method can be used for both sick and healthy people. The differences between the groups were not statistically significant. In particular cases, however, the differences between the healthy people and patients with seborrhoeic dermatitis were noticeable and the patients demonstrated a decreased level of the antioxidant capacity.

In pathological states the increase in the number of free radicals leads to the decrease in the cell protective capacity, which in turn makes the change in the total antioxidant capacity. In many pathological states very often TAC gets decreased, which might result from weakening antioxidant mechanisms. The decreased level of the antioxidant potential is the proof for a stronger activity of various oxygen forms which might play a role in etiopathogenesis of seborrhoeic dermatitis. Besides, the decreased level of the antioxidant capacity can be caused by overproduction of active oxygen forms, the synthesis of which may be intensified due to a chronic, inflammatory state of the skin.

As the study findings show, the method did not prove a clear relationship between seborrhoeic dermatitis and the ability of plasma to reduce iron. However, the method should be taken into consideration while evaluating the disease, especially, its chronic and recurrent form. Conducting further research with the use of FRAP method seems to be necessary, especially in the evaluation of the results of the treatment process.

Measurement of superoxide dismutase

In physiological states free radical “sweepers”, including ZnCu-SOD, regulates the oxidative-reductive balance. The disturbance of the balance leads to oxidative stress [15-17]. When the balance between the number of reactive oxygen species and their neutralization is maintained the oxygen species do not destroy cells or tissues. In the inflammation process the generation of nitric oxide becomes more intensive. In a human body there are enzymatic and non-enzymatic mechanisms protecting against toxic influence of free radicals [18]. ZnCu-SOD is an element of intracellular enzymatic protection. The reduced activity of superoxide dismutase leads to a greater oxidative activity and the intensification of the process of membrane lipid peroxidation [19, 20]. Sezer *et al.* demonstrated the increased activity of ZnCu-SOD in neutrophilic granulocytes and erythrocytes in patients with lichen planus [21].

In the study we evaluated the activity of superoxide dismutase in erythrocytes in the patients with seborrhoeic dermatitis in comparison with the healthy people. In the group of the female patients the values were lower in comparison with the male patients. The differences were not statistically significant. The level of superoxide dismutase was statistically significant in the male patients in comparison with healthy males. Literature data do not give any examples of the course of superoxide dismutase in seborrhoeic dermatitis.

Males develop seborrhoeic dermatitis more times than females; the course of the disease is more severe and the inflammatory state – more intense [1, 2]. The activity of superoxide dismutase in erythrocytes in male patients in comparison with healthy males is here statistically significant. It may imply the activation of enzymatic antioxidative systems which act as defense mechanisms against the increased generation of reactive oxygen species.

Measurement of malonyl dialdehyde

Malonyl dialdehyde directly shows the value of lipid peroxidation and indirectly lesions in the cell membrane [4]. The disturbances of its level can be observed in psoriasis [22], contact eczema [23], vitiligo/albinism/leukoderma [24], lichen sclerosus [25], alopecia areata [26], systemic lupus erythematosus [27]. Literature data do not give any examples of the level of MDA in the course of seborrhoeic dermatitis.

The author’s own studies showed that the level of MDA in the patients with seborrhoeic dermatitis in comparison with the healthy subjects did not differ. In the males in the two groups – the study and control group the values were slightly higher but the differences were not statistically significant.

The analysis of the activity of superoxide dismutase, the level of MDA, the release of NO as well as the value of the antioxidant capacity were carried out and measured

in erythrocytes and plasma of the subjects, that is in the circulating blood. Seborrhoeic dermatitis is a disease which is able to inhibit its own course. Therefore, there are not significant changes in the studied parameters. To rule out or confirm the role of reactive oxygen species in etiopathogenesis of seborrhoeic dermatitis they should be measured also in the areas affected by the disease, i.e. the epidermis and skin.

Conclusions

Some disturbances of measured parameters of the prooxidative and antioxidative balance in the patients in the active phase of the disease may play a role in etiopathogenesis of seborrhoeic dermatitis.

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