

PREMATURE PHOTO-INDUCED AGING OF THE SKIN A CLINICAL STUDY

Lestyani Marieta*, Antonescu Angela*, Bara Camelia**

*University of Oradea, Medicine and Pharmacy Faculty, Department of Preclinical 10 1 December St., Oradea; Romania, e-mail: marietalestyan@yahoo.com

**University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea; Romania

Abstract

The sun is the source of light, heat, and therefore, of life. Among the forces of the sun, we will focus primarily on ultraviolet radiation and light radiation, which make life on Earth possible (Lionel Rossant). Ultraviolet radiation has beneficial effects on the human body, but may also have harmful effects, if it is not well put to use. Melanin is meant to protect the tegument from the sometimes too strong action of ultraviolet radiation (Cole C., Dovrat A. Weinreb O., Kuluncsics Z., Perdiz D., Brulay E., Muel B., Sage E.). Melanogenesis is the property of melanocytes of forming melanin or the melanic pigment, a dark brown substance. Uncontrolled exposure to ultraviolet radiation causes skin photo aging, which is manifested through loss of skin elasticity, the appearance of wrinkles, the appearance of irregular hyperpigmentation, thickening of the skin, therefore a rough and unpleasant look (Anisimov V., Kvetnoi I., Komarov F., Malinovskaia N.). Photo aging is often accompanied by other illnesses caused by the exposure to sunlight, such as basal cell carcinoma, malignant melanoma, etc. (Tudose N., Lazăr E., Dema A., Tuban S., Lăzureanu C., Muntean C., Roșian A., Glăja R. Cornianu M.). The syndrome of premature photo-induced skin aging presents aspects of the cutaneous aging process which are different from the aspects of physiological aging, resulting from the action of environmental factors and which may be observed mainly in the photo-exposed areas (face, neck, décolleté, hands), both with women and men (Seltow R., Berwick M, Polskz D., Marghoob A.A., Koph A.W., Bart R.S. Zigman S). The appearance of photo aging phenomena is caused by the entire ultraviolet spectrum, which alters the balance of the free radical and anti-free radical system, with multiple effects on tissue structures (Huda A, Kuluncsics Z., Perdiz D., Brulay E., Muel B., Sage E., Shore R.E., Seltow R., Berwick M, Polskz D., Marghoob A.A., Koph A.W., Bart R.S.). Histopathological changes characteristic of photo-induced aging consist in alterations of the dermal connective tissue, of keratinocytes, melanocytes, the vascular system, the pilosebaceous unit, alterations which vary in quantity and quality throughout the aging process (Seltow R., Berwick M, Polskz D., Marghoob A.A., Koph A.W., Bart R.S.).

Key words: anti-age, ultraviolet, skin, melanin.

INTRODUCTION

Ultraviolet radiation has beneficial effects on the human organism, on condition that it is well used as regards duration and that the wavelength of the radiation used is kept in minutes (Cole C, Balasubramanian D). The organism is protected against ultraviolet radiation by means of the melanin in the melanocytes. Melanin quantity varies depending on the external environment, race and the individual's genetic material (Shore R.E, Zigman S). Melanocytes contain melanosomes which are specialized in melanin synthesis and which progress from the perinuclear zone to the dendritic

zone, passing through various stages. The differences in color between white and black skin are owed to melanocytes and melanosomes (Huda A., Kuluncsics Z., Perdiz D., Brulay E., Muel B., Sage E.). The positive effects of ultraviolet radiation are indisputable, they stimulate psychophysical energies, stimulate biochemical processes in the cell, stimulate the hypophysis and suprarenal glands and favor vitamin D synthesis, the production of melanin and the regulation of sebaceous secretion (Lionel Rossant).

The negative effects of sun exposure consist especially in the lesion of DNA in cutaneous cells which may produce mutations leading to premature cutaneous photo ageing, and also to cutaneous cancers (Shore R.E., 11). The response of melanocytes to the action of ultraviolet radiation is of two types, one of which is immediate pigmentation, which takes place within a few minutes after the exposure, lasts for 6-8 hours and is the result of exposure to ultraviolet radiation type A and of visible light (Dovrat A. Weinreb O, Huda A. , Kuluncsics Z., Perdiz D., Brulay E., Muel B., Sage E). This is a pigmentation caused by the oxidation of pre-existing melanin and of its forerunners, not by the synthesis of a new pigment. On the other hand, a delayed pigmentation takes place, due to ultraviolet radiation types A and B, which occurs within 48-72 hours after the exposure, is of a persistent nature and is owed to new pigment synthesis (Huda A., Kuluncsics Z., Perdiz D., Brulay E., Muel B., Sage E, Zigman S). The role of melanin is to protect the tegument from the sometimes overly strong action of ultraviolet radiation (Anisimov V., Kvetnoi I., Komarov F., Malinovskaia N., Rapoport S., Zigman S).

The purpose of the this paper is to demonstrate the importance of gradual and controlled exposure to ultraviolet radiation in order to prevent cutaneous photo agein (Lionel Rossant, Seltow R., Berwick M, Polskz D., Marghoob A.A., Koph A.W., Bart R.S).

MATERIAL AND METHOD

The study was performed on a lot of 56 individuals of the male and female genders, which were daily exposed to the sun of their own free will. Certain individuals, even though they were informed of the harmful effects of ultraviolet radiation, did not mind the information and were pleased to expose themselves regardless of the time of day. The other patients strictly observed the proposed recommendations. All patients included in the study had thin white skin. One group was made up of 40 individuals, 34 were of the female gender and 6 of the male gender, and who were exposed to ultraviolet radiation in a controlled and rational manner, for 14 days.

The second group was made up of 16 individuals, of whom 14 of the female gender and 2 of the male gender, who were exposed to ultraviolet radiation irrationally, of their own free will, without minding the medical recommendations provided, also for 14 days.

The individuals were daily monitored, the quality of the exposed tegument being observed and analyzed: erythema intensity, wrinkle depth, the appearance of hyperpigmentation as a result of sun exposure.

RESULTS AND DISCUSSION

The harmful effects of UV radiation are highly dependent on the duration, time and gradual character of sun exposure, the human phototype and the type of protection used. Skin photo aging is manifested through loss of skin elasticity, the appearance of wrinkles, uneven hyperpigmentation, while the skin thickens and becomes rough.

By exposure to ultraviolet radiation an inflammatory process occurs at skin level, characterized by the invasion of the dermis by monocytes and neutrophils. These cells contain free radicals that are released into the tissue, leading to its destruction. Ultraviolet radiation can also cause directly the oxidation and ionization of different substances. Free radicals are unstable molecules due to the presence of a free electron in the outer shell, with a tendency to quickly regain a stable condition and are therefore very reactive, having a major influence on the redox reactions that are very important for the body.

Free radicals are involved in the aging process through the gradual accumulation of increasingly large quantities of damaged DNA, and therefore modified proteins and molecules, whose direct effect is the destruction of the surrounding structures. Structural changes occur in the dermis, a decrease in the number of elastin fibers and an increase in collagen catabolism. Collagen destruction is followed by its repair, but this process is not perfect and with the passing of time there is a loss of collagen, the skin becoming more fragile. This is how photo aged skin occurs, with fine or deep wrinkles, with irregular pigmentation, rough, inflamed, with many telangectasies.

Histological changes occurring in the skin affected by exposure to ultraviolet radiation include dysplasia and atypia, a decrease in the number of Langerhans cells, dermal elastosis appearance.

The loss of inflammatory and immunological response is more pronounced than in the physiological process of aging. Photo aging is often accompanied by other pathological phenomena due to uncontrolled exposure to solar radiation, such as basal cell carcinoma, malignant melanoma, etc. The group of individuals who were exposed in a controlled

manner to ultraviolet radiation showed no pathological changes in the skin, during or after the exposure, being monitored for a period of two months after the exposure. Individuals who were exposed to UV radiation in an uncontrolled manner suffered skin burns of grades I and II, severe solar erythema, a strong dehydration of the skin throughout the exposure. In the monitoring period following exposure a permanent tendency to skin dehydration was observed in these individuals, the tegument was unevenly pigmented, rough, with more wrinkles as compared with the period preceding the exposure. These changes were present both in male and female individuals.

The effect of direct UV exposure of the skin depends on many individual factors, primarily the constitutional (hereditary) pigmentation, determined by the melanin load in the epidermis, which can be assessed best in the areas not exposed to the sun and which is significantly influenced by race. After short exposures (less than 30 minutes) to the sun (UV), the skin of different individuals may respond through an erythema (of varying degrees of intensity) and pigmentation (optional, durable, the so-called “tanning”), of a hue that also varies from case to case and, in general, the intensity of the erythema is inversely proportional to the tanning ability. Depending on the rate at which these two types of skin response to UV radiation combine, we may distinguish six main skin phototypes (phototype I: suffers severe, painful sunburn, and never tans; phototype II: painful sunburns and possibly light shade tanning; type III: may suffer slight burns and get a dark tan tint; type IV: suffers no sunburn and tanning becomes intense; types V and VI, having the same response as type IV, are racial phototypes).

Skin manifestations caused by chronic exposure to sunlight / UV are sometimes grouped under the generic name of helio-dermatitis (or dermatoheliosis). They represent aspects of the photo-induced skin aging and may play a major role in premature skin aging.

This, unlike physiological skin aging, is the result of the action of environmental factors and is observed only in the photo-exposed areas of the skin (usually face, neck, décolleté and hands – for both sexes, and for women, legs too). The appearance of premature photo-induced aging is influenced by the full spectrum of solar radiation, especially UVB radiation (which has maximum energy capacity, a quicker effect and acts in the more superficial layers of the skin), as well as UVA or infrared radiation. Under the action of radiation the balance of the free radical and free anti-radicals system is altered: (in favour of the former), with multiple consequences on all tissue structures. Histopathological changes characteristic of photo-induced aging consist of dermal connective tissue alterations (fibroblasts, elastic fibers, collagen fibers), alterations in keratins (thickening of the epidermis in general and especially of the stratum corneum), in melanocytes

(numerical growth, disorderly hyperactivity), the vascular system, the pilosebaceous unit; these changes vary in quantity and quality from those observed during physiological aging. The fact that chronic exposure to solar radiation increases the risk of skin cancers and pre-cancers is now well documented. Solar radiation can induce alterations in nuclear DNA, abnormalities in the germinative and maturation function of the epidermal cells, a depression of the immune (self)-surveillance systems, mechanisms that can explain skin photo carcinogenesis. The various manifestations of the syndrome of premature photo-induced skin aging, such as photocarcinogenesis, occur preferentially in individuals with skin phototypes I and II (more vulnerable to lesions caused by sunlight) or in those with genetic disorders of the repair process for lesions caused by radiation (for example, people with xeroderma pigmentosum). The exercise of certain occupations that require prolonged / excessive sun exposure (farmers, fishermen, sailors, construction workers, practitioners of outdoor sports, etc.) is also a favourable factor.

Radiation interaction with matter (atoms or molecules) produces multiple effects or phenomena. Among these, the phenomena of “ionization” and “excitement” lead to the formation of “free radicals”, new atoms or molecules – representing the fundamental phenomena in producing the final radiobiological effect. The products resulting from the interaction of radiation with matter possess an odd or single electron. This gives them a chemical reactivity, the products being in this case “free radicals”. They are formed both from ionic reactions and dissociation of the excited molecules. Whenever a covalent bond is broken, primary electrons remain available: $R : S \rightarrow R \cdot + S \cdot$. Free radicals have a short life in general (but there are weaker radicals, too), just like the excited molecule.

During this time, they may interact with other molecules, changing their activity or inactivating them, with the respective metabolic consequences. Also, they can combine together to form a stable molecule. Free radicals can be identified through various methods, among which the most commonly used is the “electron paramagnetic resonance” (EPR).

Depending on the dose of radiation absorbed and a number of conditions of the irradiated environment, there are changes in the biological molecules, which can be produced either directly, by the incident radiation, or indirectly, through the free radicals. These changes, which underlie the radiobiological effect, justify the high priority given to free radicals. As the number of modified molecules – inactivated or not – or products can be determined quantitatively, the quantitative correlation with the radiant energy transferred could be established. The number of molecules modified or produced by the amount of 100 eV bears the name of “radiochemical yield” and is denoted by the letter “G”. Radiochemical yield is commonly

expressed as the ratio between the number of modified molecules (M) and the number of pairs of ions (N) produced from the radiation used. Radiation action at the molecular level occurs either directly (where the ionized or excited molecule itself is changed) or indirectly (if the molecule is changed by transferring energy from another molecule). The radio-chemical yield is smaller for the indirect effect than for the direct one. It is estimated that the inactivation of one molecule by indirect effect requires 10-100 ionizations, and only one ionization when the effect is direct. There is information that can serve as a basis for developing a low-risk behavior, namely:

- the susceptibility to UVR injury can be reduced by using appropriate clothing to protect the whole body, including hands and feet. The head will be covered by a hat with wide brims, a significant reduction could be achieved through the appropriate use of physical and chemical sun screening products. The maximum photo-protection is provided by chemical solar screens with an SPF of 15 or more, an attitude that limits sun exposure must be acquired (figure 2, 3,4, 5, table 2).

Epidermis, hair follicles and sebaceous glands in UV lesions. Existing data suggests that 50% of the total time of an individual's exposure to the UVR is recorded until the age of 18years. Therefore, parental education is very important. All the evidence shows that excessive exposure to both natural and artificial UVR is harmful.

CONCLUSIONS

The following conclusions can be drawn from the study:

1. The cutaneous manifestations caused by uncontrolled exposure to ultraviolet radiation represent aspects of the process of photo induced cutaneous ageing, with a major role in premature skin ageing.

The whole spectrum of solar radiation, especially types B, A, as well as infrared radiation contribute to premature skin ageing.

2. Under the action of ultraviolet radiation, the equilibrium of the free radical system is altered, with multiple consequences on all tissular structures.

The various manifestations of the photo induced premature cutaneous ageing syndrome, as well as photo carcinogenesis, preferably occur in individuals with skin photo types 1 and 2.

3. Photo aged skin is thickened, non-uniformly pigmented, dry, lacking elasticity, striated with numerous wrinkles and telangiectasia.

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