

## The Sports Cellulite and the Microtraumatism as a Result of Oxidative Stress in Athletes (Hypothesis)

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The investigations upon athletes show that the typical cellulite of the “women pool” is considerably less found in them. At the same time there is cellulite in sportsmen from the two sexes in their most overloaded body zones. The author calls this type of cellulite, related to the most intensively overloaded body zones “sports cellulite”. The hard physical exercises are prerequisite for the formation of cellulite. This is mostly due to the oxidative stress — increase of the harmful Oxygen Free Radicals (OFR) and switching of the specific vicious circle of the cellulitogenesis. The cellulite speeds up the degeneration of the tissues, embarrasses the regular circulation and draining, leads to early growing old of the cells and tissues of the affected muscles and joints — microtraumatism. Then the very intensive physical exercises are also a prerequisite for the simultaneous formation of the cellulite and microtraumas.

*Key words:* cellulite, oxidative stress, oxygen free radicals, microtraumatism.

### Introduction

The Cellulite (Edematose Fibrosclerotic Panniculopathy) is a metabolite illness of the fat and connective tissue in the hypoderma [1, 3, 7, 10]. It is most commonly found in women and is effecting prevalingly the trighs, hip and belly (“the women pool”). In women, vertical fibers of connective tissue segregate fat into columnar pockets. Cellulite develops when small blood vessels in the fat layer become damaged. The circulation of blood and lymph slows, and fluid accumulates. Although the layer of fat swells, the fat tissue remains tethered to connective tissue, creating puckers [10, 12]. The investigations upon athletes show that this typical cellulite of the “women pool” is considerably less found in them. At the same time we ascertained that it is found cellulite in sportsmen from the two sexes in their most overloaded body zones (in scullers and volleyball players on the shoulders and armpits, in bicyclists on the thighs and underthighs, etc.) [15, 16]. The very intensive physical exercises are also a prerequisite for the simultaneous formation of the microtraumas [13].

The purpose of this paper is to confirm the concept of oxidative stress as a potentially important contributor to tissue damage. The role of oxidative stress has been hypothesized in many clinical situations, but here attenuation will be focused on its

possible role as a reason for formation of sports cellulite and microtraumas in the athletes.

## Oxidative stress in the athletes

On principle, during the normal physiological reactions in the cells and tissues of the organism are acting harmful oxidative processes, which produce as a result oxygen free radicals (OFR). During the reduction of electrons from the oxygen molecule is generated a superoxide radical ( $\bullet\text{O}_2^-$ ), a hydroxyl radical ( $\bullet\text{H O}$ ) and a hydrogen peroxide ( $\text{H}_2\text{O}_2$ ). It is considered that under physiological conditions for one year in the organism of a middle-aged man there are generated about 2-3 kg only from the superoxide radical.

Oxidative stress, defined as a disturbance in the balance between the production of reactive oxygen species (OFR) and antioxidant defenses which may lead to tissue injury.

From physiological point of view the ways for production of OFR during the physical strain are many. The most important of them are the changed metabolism arachnoid acid, activation of phagocytes and oxygen deficiency with its payment. The stress (physical and emotional) is also very important, leading to an increase of catecholamines (Adrenalin and Noradrenalin) and their antioxidation, connected with generation of many reactive metabolites and reactive peroxides. During intensive physical strains their production is increasing. During intensive and long-term physical strains in the body of the athletes are generated a lot of these reactive metabolites and they cause oxidative stress. The abrupt increase of the catecholamines is leading to their violent destruction through auto-oxidation, the result of which is ( $\bullet\text{O}_2^-$ ). After the ceasing of the strain the resynthesis of the catecholamines from fenilalanin is once again combined with new generation of OFR. Therefore both the disintegration and the resynthesis of the catecholamines are leading to generation of OFR and pre oxidation of the lipids [2, 6]. In the beginning of every intensive physical strain it is accumulated an excess post-exercise oxygen consumption. The anoxion stimulates the intensive catabolism of ATP and leads to accumulation of purinal metabolites — hypoxantin and xantin. During the succeeding process of reperfusion there is explosive oxidation of the accumulated purines with generation of both uric acid (antioxidant) and superoxide radicals.

During the physiological enzyme detoxication of  $\bullet\text{O}_2^-$  with the participation of superoxid-dismutasis (SOD), is formed the intermediate product  $\text{H}_2\text{O}_2$ , the neutralization of which is taking place on the following two ways: through catalasis (CAT) and through glutathion peroxidasis (GPX). The insufficient activity of GPX could become a reason for the accumulation of  $\text{H}_2\text{O}_2$ , which is leading to a tissue acidosis [9, 11]. The huge amount of  $\text{H}_2\text{O}_2$  and the availability of  $\text{Fe}^{2+}$  are initiating the reaction of Haber Weiss. During the this reaction are generated a lot of hydroxyl radicals ( $\bullet\text{HO}$ ), which due to their very short half-life (only  $10^{-8}$ ) are exclusively reactive, and especially locally — on the place of their generating /in the hipoderma and the muscles/, thus damaging the cellular membranes and the very cells [5, 8, 13, 16]. Due to the lower possibilities of the hypoxical tissues of detoxication, in the hipoderma are accumulated other OFR, as well as products of the precis oxidation of the lipids, including conugates of dien, manol dialdehyde, etc.[5, 11]. All of OFR are damaging the cellular membranes, the cells and tissues, with which they come into contact. Their harmful action is not only on the place of their generation, but reaches the neighbouring tissues as well. Their accumulation causes a degradation of the hialironic acid and the collagen, damaging of the cells through peroxidation of the polinotsaturated fat



acids and destruction of the permeability of the cells membranes and the structural elements. It is even possible to be got to acidosis with the additional after-effects for the tissue.

## Sports cellulite

In order to prevent its vitally important organs and systems from the progressively increasing harmful products (OFR), the organism of athlete acts according to the Law for common biological adaptation, by storing them and gradually organizing them in its hypoderma. There are formed cellulite nodules — new morphological structure, which worsen the common state and outside look of the skin. We call this type of cellulite, related to the most intensively overloaded body zones “sports cellulite”. We think that it is a result of the heavy physical overloading in definite body zones, related to the corresponding sport, and once again the basic reason for it are the oxidative processes. Therefore the hard physical exercises are prerequisite for the formation of cellulite. This is mostly due to the oxidative stress — increase of the harmful OFR and switching of the specific vicious circle of the cellulitogenesis : Hypoxy in the hypoderma-Oxygen Free Radicals — Lipid Peroxidation — Activation of Protein-cinasis — Desensetisation of Beta-receptors — Disbalanced Lipolysis — Poor Microcurculation in the skin — Local Hypoxy — Sports Cellulite in the skin. This is the process of generation of Sport cellulite from hard physical exercise [15,16].

## Microtraumatism

The exhaustive exercise may cause oxidative damage in muscles through the activation of neutrophils [13]. Exhaustive exercises significantly decrease GPX and CAT, include a process of irreversible changes associated with accumulation of OFR and damage of the cells [4, 8, 11].

The topographical structure of the body is showing that there is a direct interdependence between the tissues in depth. The skin and the hypoderma are directly dependent in their feeding, draining and innervation (afferent and efferent) on the below lying muscles, sinews and other deeper lying tissues. The generated OFR act simultaneously upon all of them. The changes in the active tissues under one zone of the skin reflect upon the skin itself. The muscles, which are loaded to their maximal limit absorb a large amount of oxygen and generate a great number of OFR. At the same time the laid on the surface hypoderma and skin remain in hypoxia, which causes them to generate OFR as well [2, 8, 11, 14]. Therefore due to different factors the two neighbouring in topographic relation structures generate abundantly harmful reactive metabolites of oxygen. Thus during a heavy physical training of a given part of the body in its hypodermal structures, on the one hand, there is lack of oxygen and energetic substances and, on the other hand — a great accumulation of waste products, i.e. the tissue is hardened with metabolites, and at the same time its possibilities to neutralize them are diminished. This is very characteristic in conditions of local hypoxy, where the possibility for neutralizing the metabolites is lower due to the lower activity of the oxygenases. This slows down the speed of the oxidative phosphorylation and as its result the resynthesis of ATP. The concentration of NADP is changing, and it affects the interrelation between the restoring and oxidated glutation (GSH : GSSG). The disturbed restoration of GSH is reflecting negatively to the activity of the GPX, which makes harmless the generated during the neutralization of the SOD hydrogen peroxide [4, 6, 11, 14]. The oxidative processes in these excessively overloaded body zones are leading to damages in the cells and tissues. This is most relevant for the muscles,



sinews, joint capsules and ties. Thus the harmful OFR switch the vicious circle of the cellulite and microtraumatism in the athletes: Hard Physical Exercises — Oxygen Free Radicals — Release of Proteolytic enzymes — Increase Permeability of cell's membranes — Flux  $Ca^{++}$  ions in the cells — Phospholipase-A2-activation — Activation of Arachnoid acid — Increase  $\bullet HO$  - Degeneration of tissue — Microtraumatism [16].

Our studies reveal that 81,24 % from the athletes with complaints from different microtraumas are with good expressed sports cellulite in the same place. That is why, by diagnosing on time the sports cellulite through thermography we may receive information about the condition of the underlying tissues and for the eventual danger of microtraumas [15, 16].

## Conclusion

The disturbed metabolism, the limited lipolysis and the growing connective tissue are one additional reason for the worsening of the status of the relative body zone. They reflect negatively to the lower-laid active structures (muscles, sinews, ties) due to their topographic interdependence. The outside reaction, diagnosed through the skin is cellulite in different stages, which is a direct result of the degenerative processes, taking place in the lower-laid tissues. The tissue changes in the lower (active) structures of the most overloaded body zones of the sportsmen are projected upon the surface of the body (upon the skin), which is a possibility for us to discover them early. The diagnostics of cellulite in athletes could be used as a screening check-up for the discovering of still not revealed microtraumas in the most overloaded body zones. In the same manner it is possible to be followed up and registered the effects of the undertaken prophylactic or curative treatment.

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