Subcutaneous adipose tissue histological study at laser treatment of the human skin *in vitro*

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Abstract

Histological slices of skin samples with the subcutaneous adipose tissue after laser irradiation at different doses are analyzed. These data plan to be used at carrying out of the analysis of histological slices of skin samples with the subcutaneous adipose tissue after photodynamic therapy. The data obtained are important for safe layer-by-layer dosimetry of laser irradiation used in the treatment of obesity and cellulite.

Introduction

There are many methods for removing of unwanted body fat. Liposuction - the most common way to remove fat deposits [1, 2]. The application of his method is accompanied by necrosis of adipocytes which were not removed at liposuction [2].

The optical method of fat tissue destruction, namely photodynamic/phototheral method, may provide reduction of regional or site-specific accumulations of abdominal or subcutaneous adipose tissue least-invasively by inducing of cell apoptosis and controlled necrosis of the small amounts of fat tissue [3]. In particular, it relates to the employment of localized optical (laser) radiation of the appropriate wavelength and power, which also may be integrated in conjunction with localized specific fat tissue staining or lipolytic agent application, to noninvasive and non- or least-destructively downsize fat tissue volume and thereby modify contour/shape local target adipose tissue.

The **goal** of this work was **to analyze histological slices of skin samples with the subcutaneous adipose tissue after laser irradiation at different doses**.

Materials and methods

The best known and most widely used staining procedure, hematoxylin-eosin staining (H&E), uses hematoxylin solutions for nuclear staining and eosin solutions for cytoplasmic staining [4]. In the first step, the nuclei are stained with a hematoxylin solution. The nuclei stain is blue, dark violet to black. The second step is counterstaining with a xanthene dye, e.g. eosin Y, eosin B or erythrosin B. In this process cytoplasm, collagen, keratin and erythrocytes stain is red. H&E staining is the standard staining method used in histology. It gives an overview of the structure of the tissue, enabling differentiation of the structures being examined as normal, inflamed or degeneratively changed, or pathological. In the experiments, samples of human skin with subcutaneous tissue of thickness of 1.5-2.5 cm taken after surgery of the patient (woman, 58-year old) were used. A diode pumped solid state laser (808 nm) with the power density of 100 - 300 mW/cm^2 was used as a light source. The exposure time was of 0.5 - 8 min. The tissue samples were irradiated by laser. Optical fiber was directed perpendicular to the tissue surface. For histological examination of irradiated and control samples, fixation was carried out by 10% solution of formaldehyde. After fixation histological slides were prepared and stained by hematoxylin-eosin according to standard technique [4]. After fixation the slices was made 5-7 μm were analyzed. Samples of human skin with subcutaneous tissue were cut across all layers.

Results and discussion

The control sample demonstrated no pathological changes (Fig. 1).

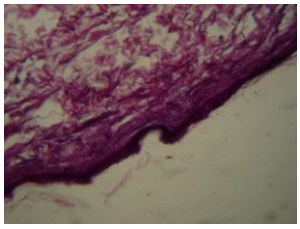
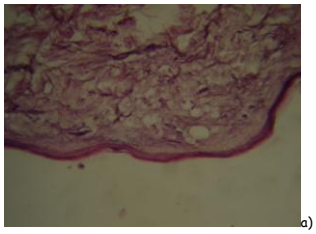
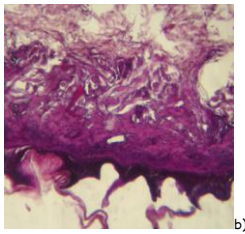


Fig. 1. Image of a subcutaneous adipose tissue. Control sample



a)



b)

Fig. 2. Images of subcutaneous adipose tissue samples after laser irradiation during 8 and 0.1 min (a, b). Diode pumped solid state laser, 808 nm, power density 150 and 300 mW/cm^2, accordingly

At sample irradiation with the power density of 150 mW/cm^2 and exposure time of 8 min, and more, in histological preparations marked destruction of irregular shape was determined, in which the boundaries between the cells of the epidermis erased, cell nuclei are fragmented. There was marked desquamation of the stratum corneum in these samples. In the dermis marked signs of destruction of connective tissue can be seen: homogenization and swelling of the fibers, the destruction of the cell nuclei. In histological preparations the signs of skin damage are expressed to a much lesser extent when power density was 150 mW/cm^2 with the exposure time of 1.2 min or less. Major changes are localized in the dermis and presented by swelling of connective tissue fibers without their destruction. The smallest changes were observed with minimal impact at100 mW/cm^2 with the exposure time of 0.5 min.

Changes of the subcutaneous adipose tissue were not observed. The result allows us to propose that to provide any action on adipose tissue with no damage of skin layers at this particular wavelength we are able to use selective staining of adipose tissue, using such absorbers as indocyanine green or gold nanoshells.

Acknowledgments

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