Abstract

Diabetes mellitus is a chronic metabolic disease characterized by hyperglycaemia resulting from the insulin malsecretion or malfunction. Diabetic retinopathy is a microvascular complication of diabetes mellitus and has become one of the leading causes of blindness in developed countries.

Abnormal blood glucose levels cause loss of the blood-retinal barrier integrity, retinal ischemia and stimulate retinal neovascularization. An increased activity of protein kinase C, vascular endothelial growth factor and a process of leukostasis are the main pathways of the diabetic retinopathy pathogenesis.

The standard treatment involves laser therapy and intravitreal drug administration of angiogenesis inhibitors and anti-inflammatory agents. Late complications of diabetic retinopathy may be surgically managed by the vitrectomy procedure. Novel alternative therapeutic options in the diabetic retinopathy include antioxidative agents, mesenchymal stem cells and islet cell transplantation.

The standard diagnostic process requires a fundus examination at the slit lamp and a retinal imagining compromised by fluorescein angiography and optical coherence tomography (with vascular assessment).

Adaptive optics technology is a novel tool in the diabetic retinopathy diagnosis. Rtx1^{TM} (Imagine Eyes, Orsay, France) is a device using the innovative technique, that allows the visualization of single retinal cells (photoreceptors) and microcirculation. The measurements are non-invasive, repeatable and easy to perform.

The doctoral study analysed a possible influence of BMI values on the retinal microstructure. The study group consisted of 28 women diagnosed with overweight or obesity; the control group involved 19 women with BMI <25. Rtx1^{TM} camera analysis showed that the mean lumen and total diameter of the analysed retinal arteries were not significantly BMI dependant. The study revealed some early symptoms of vascular pathology such as the increased thickness of retinal arterioles, higher WLR and WCSA parameters in obese and overweight women.

Rtx1^{TM} technology was successfully used in the doctoral study as a method of photoreceptors and retinal vasculature assessment over time in patients with diabetic retinopathy. The study involved 50 diabetic individuals (type-1 or type-2 diabetes mellitus) and 18 healthy volunteers. The patients participated in 3 visits- the initial visit and two follow-up appointments, one and two years after the study. Each visit consisted of best-corrected visual acuity (BCVA) assessment, OCT macula scanning (3D DRI OCT Triton) with central retinal thickness (CRT) evaluation and AO retinal image acquisition.

The initial phase of study revealed that the cone density in diabetic patients was significantly lower than in the controls. Moreover, in a 2-year follow-up, cone parameters' changes were more substantial in the diabetic than in the healthy group. Microvascular retinal morphology changes such as the increase in WLR and the mean value of artery walls were observed throughout the diabetes mellitus duration.

The rtx1^{TM} camera was applied in the early detection of disruption in the retinal microstructure throughout the course of the obesity, the prediabetes and the early stages of diabetic retinopathy. Adaptive optics is a promising tool in the early diagnosis, pathyphysiology analysis as well as future therapeutic discoveries in the metabolic diseases.