

UDC 3219.01

Eye diseases

PHOTOPROTECTION AND ITS APPLICATION IN LASER CORNEAL REFRACTIVE SURGERY

A.I.Sultanova

(Presented by Academician of ANAS A.T.Amiraslanov)

The data of the literature on photoprotection and its implementation in relation to the organ of vision was analyzed. Photoprotective function of the cornea and its changes after laser refractive surgery were considered. New approaches to photoprotection in different excimer laser corneal surgery were proposed and their pathogenetic orientation was proved. These approaches have been applied in the clinic while doing transepithelial PRK and FemtoLASIK on 378 eyes, 196 patients with myopia and myopic astigmatism of varying degrees. The efficiency of photoprotection in keratorefractive laser surgery was demonstrated.

Keywords: photoprotection, keratorefractive laser surgery, transepithelial PRK, FemtoLASIK

Relevance

Photoprotection is a broad concept, which implies a set of measures aimed at reducing exposure to ultraviolet (UV) radiation on the cells, tissues, organs and entire human body. The human eye is a unique organ, transforming into visual perception of falling on it an external electromagnetic flow of light photons of different spectral range. Compared with other organs the eyes bear the greatest burden of UV over a lifetime. In defense of the intraocular structures the important role is played by the cornea, which holds the most dangerous of biophototoxic action UV photons medium (UVB) spectral range [1-3]. This should be borne in mind when carrying out laser keratorefractive operations, which are often accompanied by its thinning and weakening of photoprotective function [4,5]. Besides, at the excimer laser ablation an additional UV irradiation and local oxidative stress, having a damaging effect on keratocytes and collagen structure of the corneal stroma [6-9] also presents. This can significantly affect the response aseptic and regenerative response, and change the final refractive effect [10-11].

Objective of essay. To consider the basic approaches to photoprotection at a level of authority to justify their use in the stages of laser corneal refractive surgery.

Material and methods

We analyzed the literature data, which predicts the notion of photoprotection and methods of its implementation with regard to the human eye. New approaches to photoprotection in different excimer laser operations on the cornea were evaluated in the clinic when the transepithelial FemtoLASIK and PRK were done on 378 eyes, at 196 patients with myopia and myopic astigmatism of varying degrees. Laser refractive excimer-laser surgery was performed on excimer laser ophthalmic device "MEL-80", Wavelight EX "-500" and ophthalmic femtolaser VisuMax and E200. A set of diagnostic equipment system WaveLight® Refractive Suite was used.

Results

During the performing of transepithelial PRK (TFRK) and operations FemtoLASIK with photoprotection, envisaging the refractive ablation after pre-saturation of the corneal stroma with riboflavin, it was noted a decrease in the severity of postoperative aseptic inflammatory and regenerative reactions. Application of photoprotection during TFRK surgery allowed to minimize corneal and pain syndrome. Time of onset of epithelialization ablation zone was reduced by an average of 30° / a over the results of TFRK without photoprotection. In assessing the 5-point scale the degree of transparency of the cornea ranged from 0 to 0.5

points, which had no effect on visual acuity. In neither case were observed partially reversible and irreversible forms of subepithelial prematurity. Whilst carrying out the FemtoLASIK with photoprotection all patients reported subjective feelings more comfortable in the eye than another eye on which surgery FemtoLASIK was carried out according to traditional methods. A month after the operation deviation from the calculated refraction does not exceed ± 1.0 diopters were noted in 89,3 % of the cases after the TFRK and 91,7 % after FemtoLASIK surgery [12].

Regardless of the specific technology of excimer laser refractive surgery had fewer fluctuations optometric performance and more stable refractive results. Moreover, as shown by clinical observations in the postoperative period additional optical spectral photoprotection from external UV radiation is needed. With this purpose, wearing sunglasses or a Polaroid glasses until complete stabilization and optometric visual indicators was prescribed. Drug general and local photoprotection in the postoperative period depended on the particular type of operation and the degree of myopia correctable. In all cases, drug therapy was individualized, taking into account the primary aseptic response, which was the main marker of corneal syndrome in the early postoperative period. Particular emphasis has been placed by us on indirect photoprotective estimate for general and application of non-steroidal anti-inflammatory topical drugs (NSAIDs) on the preparatory stage and after photorefractive operations with a focus on technology of transepithelial PRK. In addition, the positive effect of NSAIDs during laser operations keratorefractive manifested in reduction of pain symptoms and aseptic inflammatory and regenerative response in response to ablation of the stroma.

Discussion

Photoprotection becomes extremely important in relation to the organ of vision, the bearing, as already mentioned, the greatest and ultraviolet light load. Moreover, not only UV radiation but also short wavelength blue-violet range of the visible spectrum may cause excessive accumulation of peroxide radicals in the

eye at the age weakened accommodation, hemo- and hydrodynamics. This concerns not only the retina, but all of intraocular structures. As a result of the accumulation of peroxide radicals ophthalmopathology develops. Not by chance nature has provided a special system of gradual spectral filtering of the luminous flux from the cornea to the retina photoreceptors. First of all, it is a protection from UV photons and blocking macula lutein of high energy beams of short-wave blue-violet spectrum. This unique system of photoprotective protection formed during the long adaptation of organ of vision to the surrounding light environment. The main recommendations to protect the eyes from the outside UV are wearing sunglasses. However, the analysis showed that in most cases glasses are not always used correctly when being under increased foreign UV solar load, such as during the stay on the beach. Thus, the periodic removal and wearing of glasses the microvilli of pigment epithelium cells do not have time to escape from the outer parts of the photoreceptors exposure to light photons. Thus there is a photon impact on retinal photoreceptors, and the conditions for their damage due to amount of peroxide radicals of photoreceptor membranes that are formed in the course of the photochemical reaction, are created.

Any refractive surgery on the cornea using laser radiation of different spectral range creates oxidative stress conditions in the cornea. First of all, it concerns the carrying out photorefractive keratectomy [6-8]. For example, during laser ablation of excimer laser radiation with a wavelength of 193 nm, despite the fact that most of the excimer laser radiation is absorbed, some of it is transformed into a longer wavelength in the range from 310 to 330 nm [13-14]. This radiation leads to a cascade of fluorescence protein collagen of the corneal stroma and creates a suggestive effect of secondary fluorescence. Secondary radiation penetrates much deeper than the vaporized layer of the corneal stroma, and this effect increases due to ablation. With the increase in the total amount of corneal ablation, the total dose of radiation transformed corneal excimer laser in-

creases. This causes the effects of stimulation or appoptoza of keratocytes and may lead to an inadequate response to the development of regenerative reaction fibroplasias.

As shows the clinical observations the deviation from the planned refraction, due to inadequate response regeneration takes place even when the photorefractive ablation on LASIK and FemtoLASIK technology [15].

Conclusion

1. In carrying out photorefractive thinning operations in the central optical zone of the cornea its photoprotective is violated.

2. Saturation of the corneal stroma with riboflavin before excimer laser refractive keratectomy provides photoprotecting underlying structures of stroma from induced ablation of the secondary UV radiation.

3. The spectral optical UV photoprotection shown after laser keratorefraction operations till complete stabilization and optometric visual indicators.

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*National Ophthalmology Center named after
Acad. Zarifa Aliyeva, Baku, Azerbaijan
s.eye@mail.ru*

BUYNUZ TƏBƏQƏNİN FOTOMÜHAFİZƏ FUNKSIYASI VƏ ONUN LAZER REFRAKTİV CƏRRAHİYYƏSİ

A.İ.Sultanova

Fotomühafizəyə dair ədəbiyyatda olan məlumatlar və görmə orqanı ilə bağlı istifadəsi təhlil edilmişdir. Buynuz təbəqənin fotomühafizə funksiyası və onun lazer refraktiv əməliyyatından sonrakı dəyişməsi nəzərdən keçirilmişdir. Müxtəlif ekzimer lazer buynuz təbəqəsi əməliyyatı üzrə fotomühafizəyə yeni yanaşmalar təklif edilmiş və onların patogenetik oriyentasiyası təsdiq edilmişdir. Bu yanaşmalar klinikada miopiya və müxtəlif dərəcəli miopik astigmatizmi olan 196 pasiyent, 378 göz üzərində transepitelial fotorefraktiv keratektomiya (PRK) və FemtoLASİK zamanı tətbiq edilmişdir. Keratorefraktiv lazer əməliyyatında fotomühafizənin effektivliyi nümayiş etdirilmişdir.

Açar sözlər: fotomühafizə, keratorefraktiv lazer əməliyyatı, transepitelial fotorefraktiv keratektomiya (PRK)

ФОТОПРОТЕКЦИЯ И ЕЁ ПРИМЕНЕНИЕ В ЛАЗЕРНОЙ РЕФРАКЦИОННОЙ ХИРУРГИИ РОГОВИЦЫ

А.И.Султанова

Проанализированы данные литературы по фотопротекции и её реализации применительно к органу зрения. Рассмотрена фотопротекторная функция роговицы и её изменения после лазерных рефракционных операций. Предложены новые подходы к фотопротекции при различных эксимерлазерных операциях на роговице и обоснована их патогенетическая направленность. Данные подходы были применены в клинике при выполнении трансепителиальной ФРК и ФемтоЛАСИК на 378 глазах, 196 пациентов с миопией и миопическим астигматизмом различной степени. Показана эффективность фотопротекции в лазерной кераторефракционной хирургии.

Ключевые слова: фотопротекция, лазерная кераторефракционная хирургия, трансепителиальная ФРК, ФемтоЛАСИК