IJAE
Vol. 116, n. 1 (Supplement): 118, 2011
ITALIAN JOURNAL OF ANATOMY AND EMBRYOLOGY

The human corneal epithelium after alcohol delamination: a structural and ultrastructural study

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Dilute alcohol is one of the most popular methods for corneal epithelial removal during photorefractive keratectomy (PRK) and laser subepithelial keratomilieusis (LASEK). Even if the technique is used by nearly fifteen years, no concordant data are available on the effects of the exposition to dilute alcohol on the corneal epithelium. As in LASEK the epithelial flap obtained by the previous delamination is repositioned to improve corneal recovery, aim of the present work was to investigate the structure and the ultrastructure of the corneal epithelium after alcohol delamination.

Ten patients undergoing PRK for myopic correction were consecutively included in the study. A 9-mm diameter cone was placed on the anaesthetized cornea and it was filled with 25% ethanol in BSS for 25 seconds. The cone was emptied and the corneal surface was washed off with BSS. The epithelial layer was lifted with beaver blade, peeled off with forceps, and processed for light (LM) and transmission electron microscopy (TEM).

With LM, whilst superficial and wing cells showed a normal appearance, basal cells had significantly different staining patterns. In fact, in the same microscopic field they showed either normal morphology or paler nuclei and cytoplasm. When the specimens were observed with the TEM, all epithelial cells showed well-preserved intercellular spaces and junctional complexes. In the superficial cells perinuclear vacuolizations were present, whilst wing cells demonstrated no evident morphological changes. Clear basal cells had roundish nuclei with pale chromatin and clear cytoplasm with perinuclear endoplasmic reticulum and mitochondria and a large number of tonofilaments. Their basal membrane was generally intact, with many hemidesmosomes adhering to the basement membrane, which was formed only by the laminae lucida and densa. Dark basal cells showed irregular nuclei with condensed chromatin, vacuolated cytoplasm and few basal hemidesmosomes.

Alcohol debridement can be considered as a valuable technique for removing corneal epithelium before PRK or for preparing an epithelial flap before LASEK: in fact it affects the binding of hemidesmosomes to the underlying basement membrane so that the lamina densa is separated from the lamina fibroreticularis. However, the observation of structural and ultrastructural changes of the basal cells, similar to those demonstrated in epithelial flaps obtained with the epikeratome, indicates the need for further studies to evaluate the corneal toxicity of the ethanol.

Keywords: Corneal epithelium, alcohol delamination, hemidesmosomes, basal cells, ultrastructure