doi 10.18699/bgrs2024-9.5-05

Human corneal stromal cells have a high potential for regeneration

Poveshchenko O.V.[1]*, Krasner K.U.[1, 2], Surovtseva M.A.[1], Kim I.I.[1], Bondarenko N.A.[1], Chepeleva E.V.[1], Lykov A.P.[1], Gayvoronskaya A.A.[1], Trunov A.N.[2], Chernykh V.V.[2]

[1] *Research Institute of Clinical and Experimental Lymphology – Branch of the Institute of Cytology and Genetics, SB RAS, Novosibirsk, Russia*

[2] *Novosibirsk Branch of S. Fyodorov Eye Microsurgery Federal State Institution, Novosibirsk, Russia*

** poveschenkoov@yandex.ru*

Key words: cornea; stromal cells; keratocyte; fibroblast; Relex Smile; corneal regeneration

Motivation and Aim: Corneal blindness is the third leading cause of low vision after cataracts and glaucoma [1]. Due to the shortage of donor corneas, new approaches to the treatment of corneal blindness are being sought. Such approaches are cell therapy and the development of tissue-engineered corneal constructs, which are an alternative to corneal allotransplantation. Corneal stromal cells perform the function of producing and maintaining the extracellular matrix, ensuring morphostructural and biochemical stability, and the transparency of the corneal tissue [2, 3]. The aim of the study is study the functional properties of corneal stromal cells obtained from the source – ReLEx SMILE lenticules and evaluate their regenerative potential *in vivo*.

Methods and Algorithms: Stromal cells were isolated from lenticules. The differentiation of corneal fibroblasts into keratocytes was performed in a selective KGM. The cell production of cytokines and extracellular matrix proteins was determined by ELISA. Injury to the corneal stroma was performed using a sharp 33G needle in the form of a tunnel defect in the thickness of the cornea of C57BL/6 mice. Then stromal cells (fibroblasts ore differentiated keratocytes) were injected into the cornea. Corneal thickness and transparency were assessed using OCT.

Results: Corneal fibroblasts and differentiated keratocytes have functional potential for regeneration, secrete fibronectin, collagen, a number of cytokines, adhesion molecules. It was demonstrated, that injury led to an increase in corneal thickness by 1.3 times on day 15, which was a consequence of trauma – iatrogenic corneal edema. The introduction of fibroblasts and differentiated keratocytes contributed to the restoration of the thickness and transparency of the mouse cornea according to OCT data after 2 months. The corneas of mice that did not receive cell injections after injury were thicker. In addition, this group also revealed high hyperreflectivity of the cornea. The opacity of the cornea of mice in groups without cell treatment after injury was due to the synthesis of collagen III and the presence of myofibroblasts.

Conclusion: Our data indicate, that lenticules, obtained with the ReLEx SMILE, may be a source of highly functional stromal cells for various tasks of regenerative medicine.

References

1. Robaei D., Watson S. Corneal blindness: a global problem. *Clin Exp Ophthalmol*. 2014;42(3):213-214. doi 10.1111/ceo.12330
2. Fukuda K. Corneal fibroblasts: Function and markers. *Exp Eye Res*. 2020;200:108229. doi 10.1016/j.exer.2020.108229
3. Young R.D., Knupp C. et al. Three-dimensional aspects of matrix assembly by cells in the developing cornea. *Proc Natl Acad Sci USA*. 2014;111:687-692. doi 10.1073/pnas.1313561110