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ORIGINAL ARTICLE

Cellular Response of Limbal Stem Cells on Polycaprolactone Nanofibrous Scaffolds for Ocular Epithelial Regeneration

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ABSTRACT

Purpose: The aim of this study was to develop nanofibrous polycaprolactone (PCL) substrate for limbal stem cell (LSC) expansion that can serve as a potential alternative substrate to replace human amniotic membrane (AM).

Materials and methods: The human limbus stem cell was used to evaluate the biocompatibility of substrates (nanofibrous scaffold and, human AM) based on their phenotypic profile, viability, proliferation and attachment ability.

Results: Biocompatibility results indicated that the all substrates were highly biocompatible, as LSCs could favorably attach and proliferate on the nanofibrous surface. Microscopic figures showed that the human LSCs were firmly anchored to the substrates and were able to retain a normal corneal stem cell phenotype. Microscopic analyses illustrated that cells infiltrated the nanofibers and successfully formed a three-dimensional corneal epithelium, which was viable for two weeks. Immunocytochemistry (ICC) and real time-PCR results revealed no change in the expression profile of LECs grown on nanofibrous substrate when compared to those grown on human AM.

Conclusion: In addition, electrospun nanofibrous PCL substrate provides not only a milieu supporting LSCs expansion, but also serve as a useful alternative carrier for ocular surface tissue engineering and could be used as an alternative substrate to AM.

Keywords: Cellular analyses, cornea regeneration, limbal stem cells, nanofibrous scaffold, polycaprolactone

INTRODUCTION

To support normal vision the renewal of the corneal epithelium is particularly important, and the source of the cells for this continuous process is found in the limbal epithelial zone surrounding the corneal periphery.[1,2] Therapeutic transplantation of the limbus has been developed for ocular surface disease and injury in which presumed stem cell deficiency has occurred;[3,4] however, in some situations healthy remaining limbal tissue may be very limited. Depletion of the limbal stem cell (LSC) population is a pathologic feature of many ocular surface diseases such as Stevens–Johnson syndrome, chemical and thermal burns, ocular surface tumors, immunological conditions, radiation injury and inherited syndromes.[5] Cell culture and clonal expansion of autologous limbal cells from the opposite eye has been increasingly used to avoid the problems associated with the need to replace corneal epithelium without reverting to allografts and the risk of immune rejection.[6–8] One of the major problems associated with stem cell therapy remains the absence of a suitable carrier for the transfer of stem cells to precise tissue locations. So far, various materials and scaffolds have been tested for the transportation of stem cells. For example, macroporous hydrogels have been used

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