Inferior Turbinate: New Source of Mesenchymal Stromal Cells
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Abstract

Objectives: Mesenchymal stromal cells (MSCs) are multipotent progenitor cells in adult tissues. Current challenges of clinical application of MSCs include donor site morbidity, underscoring the need to identify alternative sources of MSCs. This study aims to explore options of new sources of multipotent mesenchymal stromal cells for tissue regeneration and functional restoration of organ.

Methods: We isolated MSCs from human inferior turbinate tissue discarded during turbinectomy for treating nasal obstruction. The expression of surface markers for mesenchymal stem cells was assessed by fluorescent-activated cell sorting analysis. Differentiation potential of human turbinate mesenchymal stromal cells (hTMSCs) was analyzed histochemically and by RT-PCR and Western blotting.

Results: Surface epitope analysis revealed that hTMSCs were negative for CD4, CD45, and HLA expression and positive for CD73, CD90, and CD105 expression, a characteristic phenotype of mesenchymal stem cells. We could find that the extracellular matrices with cartilage and bone characteristics produced by inducing chondrogenic and osteogenic differentiation of hTMSCs and the genetic changes in neurogenic differentiated hTMSCs.

Conclusions: hTMSCs represent a new source of multipotent mesenchymal stromal cells, potentially applicable for tissue engineering and regenerative medicine. This will allow us to develop an effective tissue regenerating method with the use of autologous differentiated adult cells.

Introduction

Autologous transplantation of tissue or organ is useful method for reconstruction of damaged human structures. Because tissue sources for this replacement in human body are limited, engineered tissue is tested for the treatment option. However, cell sources of tissue engineering for the regeneration of human structure are limited also. Mesenchymal stromal cells have been a main focus to the field of tissue engineering and regeneration. Although the bone marrow stromal cells may be the best characterized of the stem cells, they are not easily obtained and are only a small percentage of the population of marrow. We sought to develop a method of cell culture that accelerates the production of cartilage, bone-specific extracellular matrix, and nervous tissue by inducing the chondrogenic, osteogenic, and neurogenic differentiation of human turbinate mesenchymal stromal cells (hTMSCs). Also, we aim to use this method as a original technique for tissue regeneration and functional restoration of organ and to develop the new cell source for mesenchymal stromal cells.

Methods

This study aims to isolate the mesenchymal stromal cells from human inferior turbinate tissue that is removed and discarded during turbinectomy, often executed in Otolaryngology for treating nasal obstruction; to find out whether or not extracellular matrix with cartilage and bone tissue characteristics can be produced by inducing chondrogenic and osteogenic differentiation of these cells; to determine the genetic changes in neurogenic differentiated hTMSCs; to apply the results of this research clinically by using its ability to regenerate and restore function to the human skeletal and nervous structures. By carrying out these steps, this study proposes to determine the potential of multi-lineage differentiated hTMSCs to be applied clinically, and to develop a method of cell culture which used to regenerate and restore function of tissues.

Results

hTMSCs expressed CD90, CD105, and CD73 and could be induced to differentiate into chondrocytes, osteocytes, and neuronal cells.

Figure 1. A: Schematic illustration of lateral view of right nasal cavity. B: Endoscopic view of right nasal cavity. Asterisk indicates right inferior turbinate.

Figure 2. Fluorescence-activated cell sorting (FACS) analysis of human turbinate mesenchymal stromal cells (hTMSCs). hTMSCs were devoid of hematopoietic lineage markers and expressed mesenchymal stem cell markers (after passage 3). CD34 and CD45 are markers of hematopoietic stem cells. CD90, CD105, and CD73 are markers of mesenchymal stem cells. HLA is a human leukocyte antigen.

Figure 3. Histological findings of the product of hTMSCs-seeded PCL scaffold 2 week culture. Microcavitary-like colonies of hTMSCs are scattered in the pores of PCL scaffold. A: H&E stain. B: Toluidine blue-O stain. C: Immunofluorescent staining for type II collagen. ×400.

Figure 4. Osteogenic differentiation of hTMSCs. A: Alkaline phosphatase staining at 1 week culture. B: Alizarin red staining at 1 week culture. C: Alkaline phosphatase staining at 2 weeks culture. D: Alizarin red staining at 2 weeks cultures. RT-PCR analysis of type I collagen, bone sialoprotein (BSP), Runx-related transcription factor 2 (Runx2), bone morphogenetic protein-2 (BMP-2), osterix (Ox), and osteocalcin (OC) mRNA expressions in the osteogenic differentiated hTMSCs.

Figure 5. Neurogenic differentiation of human turbinate mesenchymal stromal cells (hTMSCs) after 14 days culture

Conclusion

The above study enables us to prove that the hTMSCs can differentiate into other types of adult cells, therefore allowing us to expand the research of the multipotent mesenchymal stromal cell which has limited source of donation. This will allow us to develop an effective tissue regenerating method with the use of autologous adult cells. Also, through the autologous donation and storage of tissue that is normally thrown away during the operation, this research can establish a custom-made tissue and cell bank for patients.

This research was supported by Catholic Medical Center Research Foundation, Catholic Institute of Cell Therapy and Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science, and Technology (2010-0011249).