New stem cell therapy may lead to treatment for deafness

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Deafness affects more than 250 million people worldwide. It typically involves the loss of sensory receptors, called hair cells, for their "tufts" of hair-like protrusions, and their associated neurons. The transplantation of stem cells that are capable of producing functional cell types might be a promising treatment for hearing impairment, but no human candidate cell type has been available to develop this technology.

A new study led by Dr. Marcelo N. Rivolta of the University of Sheffield has successfully isolated human auditory stem cells from fetal cochleae (the auditory portion of the inner ear) and found they had the capacity to differentiate into sensory hair cells and neurons. The study is published in the April issue of *Stem Cells*.

The researchers painstakingly dissected and cultured cochlear cells from 9-11 week-old human fetuses. The cells were expanded and maintained in vitro for up to one year, with continued division for the first 7 to 8 months and up to 30 population doublings, which is similar to other non-embryonic stem cell populations, such as bone marrow. Gene expression analysis showed that all cell lines expressed otic markers that lead to the development of the inner ear as well as markers expressed by pluripotent embryonic stem cells, from which all tissues and organs develop.

They were able to formulate conditions that allowed for the progressive differentiation into neurons and hair cells with the same functional electrophysiological characteristics as cells seen in vivo.

"The results are the first in vitro renewable stem cell system derived from the human auditory organ and have the potential for a variety of applications, such as studying the development of human cochlear neurons and hair cells, as models for drug screening and helping to develop cell-based therapies for deafness," say the authors.

Although the hair cell-like cells did not show the typical formation of a hair bundle, the authors suggest that future studies will aim to improve the differentiation system. They are currently working on using the knowledge gleaned from this study to optimize the differentiation of human embryonic stem cells into ear cell types.

"Although considerable information has been obtained about the embryology of the ear using animal models, the lack of a human system has impaired the validation of such information," the authors note.

"Access to human cells that can differentiate should allow the exploration of features unique to humans that may not be applicable to animal models," says Donald G. Phinney, co-editor of the journal. The protocol they developed to expand and isolate human fetal auditory stem cells may be able to be adapted for deriving clinical-grade cells with potential therapeutic applications.

Dr Ralph Holme, director of biomedical research for Royal National Institute for Deaf and Hard of Hearing People, said: "There are currently no treatments to restore permanent hearing loss so this has the potential to make a difference to millions of deaf people."

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