An eye for an eye: using stem cells to treat damaged eyes and a rare skin disorder

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Doctors and scientists in Italy have shown how stem cells can be used to treat damaged eyes and, in combination with gene therapy, a rare and debilitating skin disease.

Professor Michele De Luca of the University of Modena and Reggio Emilia described the work to an international meeting of stem cell scientists in Milan (30 Sep – 2 Oct, "Challenges in Stem Cell Differentiation and Transplantation") organised by the European Science Foundation's EuroSTELLS stem cell programme in conjunction with the National Research Council of Italy.

Stem cell therapy involves the use of stem cells – 'blank' cells ('toti- or 'pluripotent') that have not differentiated into specialised cells – to generate new tissues or organs. While widespread stem cell therapy lies some way in the future, Professor De Luca pointed out that it has been used already for many years in the treatment of burns. Many tissues of the body are continuously regenerated by their own population of stem cells. In the skin, such cells are called holoclones and for decades doctors have taken small samples of these cells from burns patients and cultured the cells into new skin that can be grafted onto the wound.

Professor De Luca's team showed that cells of the transparent outer covering of the eye, the cornea, are constantly being replaced by new cells deriving from an area surrounding the cornea called the limbus. The cells differentiate into corneal epithelium and migrate to the cornea.

“If the cornea is damaged severely by a chemical burn or infection, for example, it can become opaque and necessitates a transplant,” Professor De Luca told the meeting. “However, a transplant will only be successful if the patient’s limbus has remained intact so that it can continue to replenish the new cornea.”

For many years doctors did not understand why some transplants failed – because they did not appreciate the requirement for the limbus.

In cases where the limbus is destroyed there has been little hope to restore the patient’s sight. Professor De Luca’s team decided to take a leaf from the way that burns are treated and grow a new cornea from limbar stem cells taken from the healthy eye.

By removing a small sample of these cells it was possible to culture a new cornea and graft it on to the damaged eye. The team showed that of 240 patients who were operated on in this way, the cornea regenerated successfully in 70% of cases.

The researchers then turned their attention to a rare but debilitating genetic disease of the skin resulting in a syndrome known as Epidermolysis Bullosa, in which the skin is highly fragile and prone to blistering due to faulty proteins that effectively anchor the surface layers of skin to the body.

In one form of the disease there is a mutation in one of these anchoring proteins called laminin 5. The Italian researchers obtained consent to carry out a small-scale trial of a novel gene therapy using skin holoclones on one patient, a 37-year-old male, on small part of his body .

“Because the patient’s body was so badly affected it was difficult to isolate any stem cells from his skin,” Professor De Luca told the conference. “Most people have between seven and ten per cent of

holoclones. Our man had none. Eventually we found a few in the palms of his hand and cultured them from a biopsy."

The team then used gene therapy to insert the correct laminin gene into the growing cells and grafted the new tissue onto the patient's body. The graft was successful and after several months the skin remained to all intents normal, without the blistering and flaking.

"This demonstrates that it is possible to use stem cells in gene therapy for genetic skin disorders," Professor De Luca said.

Source: European Science Foundation