Neuroprotective Effects of Intravitreal Mesenchymal Stem Cell Transplantation in Experimental Glaucoma

Thomas V. Johnson(1,2,3) Natalie D. Bull(1,2) David P. Hunt(1) , Nephtali Marina(1) , Stanislav I. Tomarev(3) , Keith R. Martin(1)

1. Centre for Brain Repair, University of Cambridge, Cambridge, United Kingdom;
3. Molecular Mechanisms of Glaucoma Section, Laboratory of Molecular and Developmental Biology, National Eye Institute, National Institutes of Health, Bethesda, Maryland.

Corresponding author: Keith R. Martin, Centre for Brain Repair, University of Cambridge, Forvie Site, Robinson Way, Cambridge, UK CB2 0PY; krgm2@cam.ac.uk.

PURPOSE: Retrograde neurotrophic factor transport blockade has been implicated in the pathophysiology of glaucoma. Stem cell transplantation appears to ameliorate some neurodegenerative conditions in the brain and spinal cord, in part by neurotrophic factor secretion. The present study was conducted to determine whether local or systemic bone marrow-derived mesenchymal stem cell (MSC) transplantation can confer neuroprotection in a rat model of laser-induced ocular hypertensive glaucoma.

METHODS: MSCs were isolated from the bone marrow of adult wild-type and transgenic rats that ubiquitously express green fluorescent protein. MSCs were transplanted intravitreally 1 week before, or intravenously on the day of, ocular hypertension induction by laser photocoagulation of the trabecular meshwork. Ocular MSC localization and integration were determined by immunohistochemistry. Optic nerve damage was quantified by counting axons within optic nerve cross-sections 4 weeks after laser treatment.

RESULTS: After intravitreal transplantation, MSCs survived for at least 5 weeks. Cells were found mainly in the vitreous cavity, though a small proportion of discrete cells migrated into the host retina. Intravitreal MSC transplantation resulted in a statistically significant increase in overall RGC axon survival and a significant decrease in the rate of RGC axon loss normalized to cumulative intraocular pressure exposure. After intravenous transplantation, MSCs did not migrate to the injured eye. Intravenous transplantation had no effect on optic nerve damage.

CONCLUSIONS: Local, but not systemic, transplantation of MSCs was neuroprotective in a rat glaucoma model. Autologous intravitreal transplantation of MSCs should be investigated further as a potential neuroprotective therapy for glaucoma.

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