Treatment of Optic Atrophy with Fetal Stem Cells

Introduction

Optic Atrophy is the loss of some or most of the fibers of the optic nerve. In medicine, "atrophy" usually means "shrunken but capable of re-growth", so some argue that "optic atrophy" as a pathological term is somewhat misleading and use "optic neuropathy" instead.

Prognosis
The optic nerve is part of the brain and has no capability for regeneration. Hence, there can be no recovery from optic atrophy and the term may refer to serious or mild, but always irreversible visual loss due to damage to the optic nerve. Three types of degeneration are seen: transsynaptic, anterograde, and retrograde.

Symptoms
There may be symptoms associated with loss of vision (although there may be a particular difficulty with color vision). Bilateral Optic Atrophy: Loss of vision and discoloration of discs in both eyes. This is a genetic form and can be inherited. Symptoms will be extremely varied. Some people will have near to normal vision, whereas others will have very poor vision.

Causes
Optic atrophy can be congenital or acquired.

Congenital
If congenital, it is usually hereditary with an onset of deterioration in childhood and may be accompanied by nystagmus. Leber's Hereditary Optic Neuropathy, (LHON) or Leber Optic Atrophy is hereditary, but typically has its onset in 20-30 year old males. This is due to a mutation of the mitochondrial genome and hence is passed exclusively through the mothers. Dominant optic atrophy or Kjer's optic neuropathy has autosomal dominant inheritance. It usually begins in early childhood. There are numerous less common genetically related syndromes.

Alternatively, congenital optic atrophy can be caused by a lack of oxygen during pregnancy, labour or in the early days of a child's life. Some drugs taken during pregnancy are also associated with optic atrophy.
Acquired

The acquired type of optic atrophy may be due to blood supply changes in the eye or optic nerve (anterior ischemic optic neuropathy or posterior ischemic optic neuropathy), may be secondary to inflammation or swelling within the optic nerve (optic neuritis), may be a result of pressure against the optic nerve (such as from a tumour), or may be related to metabolic diseases (e.g., diabetes mellitus), trauma, glaucoma, or toxicity (caused by methanol, tobacco, or other poisons). It is also seen in vitamin B12 deficiency and Paget's disease of the bone.

Method of Treatment

Preparation of stem cells

Stem cell containing tissues are extracted from the fetus’s umbilical cord before undergoing a process to isolate, purify and finally culture the stem cells, so that they can be used in a clinical environment.

Transplantation of stem cells

There are three ways in which stem cells can be injected into a patient:
1. Intravenous Injection: stem cells are injected into the patient’s vein.
2. Lumbar puncture: also known as a spinal tap, is a procedure used where stem cells can be injected directly into the spinal column.
3. Direct injection into target tissues

Results

The mean age of the treated patients was 12.7 years. The oldest patient was 55 years old. Gender distribution rate was 1:1.3 (male:female). 74% of cases reported improvements in their condition (Refer to figure below).
The type of improvements included improved vision, improved visual field, improved pattern visual evoked potentials (PVEP), and improved flash visual evoked potential (FVEP) (Refer to figure below).
Most improvements started within 4 months after the transplantation of fetal stem cells (Refer to figure below).

<table>
<thead>
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<th>Months after Treatment</th>
<th>Cases</th>
<th>Cumulative Percentage</th>
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</table>

**Conclusions**

In summary, the use of fetal Neural Stem Cells (NSCs) have shown to have a strong positive effect on the health status of 74% of the treated patients. Stem cell transplantation seems to be a safe and potentially powerful therapy for this group of patients.