

Stem cell technology to cure age-related macular degeneration (AMD)

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ABSTRACT

Abstract

Age-related macular degeneration (AMD) is a disorder that affects the retinal pigment epithelium which is a multifunctional monolayer of hexagonal cells at the back of the eye. The retinal pigment epithelium (RPE) is essential for the survival and efficiency of light-sensing photoreceptors. The loss of RPE cells in age-related macular degeneration (AMD) causes the demise of photoreceptors and everlasting blindness, RPE cell transplantation strives to cure or reverse vision loss by preventing the death of photoreceptor cells and the most prominent application is stem cell treatment in regenerative medicine. Retinal degenerative disease, such as AMD, has centred on using RPE cells transplanted from human pluripotent stem cells (HPSC). According to initial reports from clinical trials, transplanting RPE cells obtained from HPSCs can allow AMD patients to vision clear, as a proof-of-concept, RPE cell transplantation for treating other retinal degenerative diseases such as AMD, has long been demonstrated in human and animal studies involving primary RPE cells, although recent studies have concentrated on the transplantation of RPE cells made from human pluripotent stem cells (HPSC). As a part of CNS, the retina has a very poor regenerative capacity, which deteriorates, and the range of available treatments is quite small.

Keywords

Macular Degeneration, photoreceptors, retina, stem cells, genetics.

INTRODUCTION

Age-related macular degeneration (AMD) is a multifactorial disorder that is responsible for central vision loss in which there is no particular pattern of inheritance. Age, smoking, high blood pressure, and poor diet are some of the factors responsible for this condition which causes blurry vision, one of the first symptoms leading to some of the characteristic symptoms such as distorted vision and wavy visions. Globally, it is estimated that 196 million people are suffering from AMD which is elevated by 40% and is evaluated as 288 million. It is mainly caused due to the below-mentioned degenerative pathways such as dysfunctional mitochondria, oxidative stress-induced mechanisms, and regression of cascade mechanisms. Mitochondrial alterations are one of the major reasons for dry AMD that causes loss of RPE and rod photoreceptors. The RPE transports glucose from the choroid to the photoreceptors and since its degenerated the availability of glucose is reduced which damages the photoreceptors.

INTRODUCTION (CONTINUED...)

Likewise, exposure to light results in high oxygen usage and phagocytosis of photoreceptors that produces chronic oxidative stress that ultimately leads to complications like AMD, glaucoma, and diabetic retinopathy. Hence, newer stem cell technologies like Human Pluripotent Stem Cells (HPSCs) have been emerging to cure retinal degenerative diseases. HPSCs have been transplanted which reverses loss of vision by regeneration of RPE cells.

There are the three stages of AMD, normal, early and late. The yellow extracellular drusen deposits surrounds the macular area in the early stage, hypopigmentation and large number drusen deposits is accumulated in the macular area in the late stage (Figure 1).

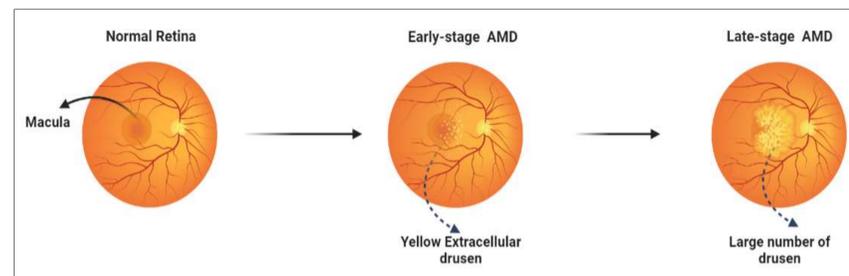


Figure 1: Stages of AMD

Causes and Risks of AMD

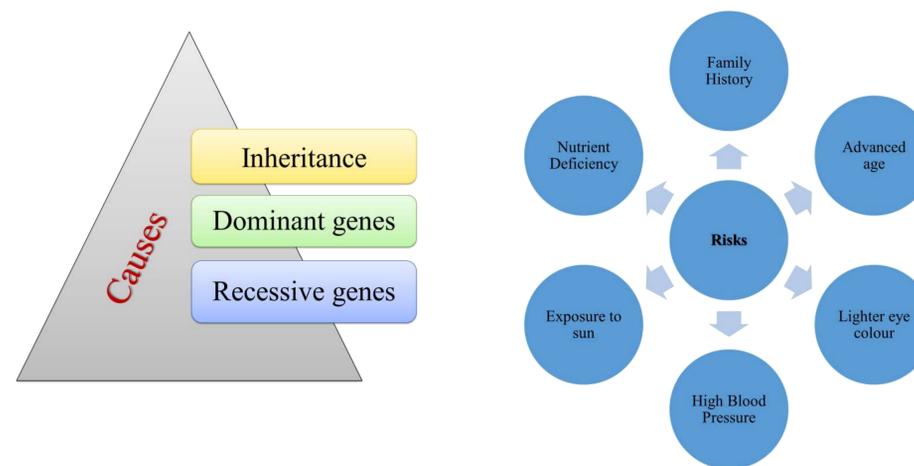


Figure 2. Causes and Risk factors of Age-Related macular degeneration

GENES ASSOCIATED WITH AMD

Table1: Genes associated with AMD

Gene symbol	Gene name	Function
<i>ARMS2</i>	Age related maculopathy Susceptibility 2	It is a component of the choroidal extracellular matrix of the eye
<i>HTRA1</i>	HtrA Serine Peptidase 1	Regulate many physiological processes, including retinal angiogenesis and neuronal survival and maturation during development.
<i>CFH</i>	Complement factor H	Plays an essential role in maintaining a well-balanced immune response by modulating complement activation.
<i>PLEKHA1</i>	Pleckstrin Homology Domain Containing A1	It is involved in the formation of signaling complexes in the plasma membrane

CONCLUSION

- The study investigates the technique used to cure a retinal degenerative disease, age-related macular degeneration that is associated with loss of vision. The method followed here is a stem cell technology that uses the human pluripotent stem cells found in the bone marrow and adipose tissues.
- Human pluripotent stem cells are also used to treat diseases like Parkinson's disease, stroke, and epilepsy.

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