



TREATMENT OF LASER-INDUCED RETINAL INJURY AND VISUAL LOSS USING SUSTAINED RELEASE OF INTRA-VITREAL NEUROTROPHIC GROWTH FACTORS

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Public Abstract

Modern battlefields are already heavily exposed to laser radiation, and it is likely that the incidence of laser-related eye injuries will dramatically increase in the future. Scattered literature reports suggest that laser-based weaponry is being developed by numerous countries to visually incapacitate an enemy. Furthermore, the relative ease of constructing laser devices increases the risk of possible terrorist attacks or accidental exposure of military and civilian personnel using laser-based weapons. Although preventative measures to reduce laser injury to the eye by using eye protection and warning systems have improved, potential for vision loss is still significant due to wavelengths of lasers that are not blocked by safety goggles and the deleterious effect of goggles on visual performance. There are currently no effective means to directly protect retinal neurons from demise if laser-induced damage occurs. Serious visual incapacitation as a result of laser-induced eye injury can have dramatic military and economic effects on society due to permanent blindness and long-term cost of medical and social care for veterans affected by this type of injury. Development of therapeutic modalities, which can be immediately used under battlefield conditions for treatment of personnel exposed to harmful dose of laser irradiation, may greatly reduce loss of vision.

There is currently no effective means to directly protect retinal neurons from dying after laser-induced damage. Anti-inflammatory medications can reduce secondary inflammation; however, conflicting data exist about the actual value of this medical treatment in patients and experimental animals with laser-induced retinal injury. Current therapeutic strategies have targeted reduction of neurodegenerative causative agents (inflammation, poor blood supply, oxidative stress from free radical formation), but it is also essential to develop new drugs that can be administered at the time of injury to prevent neurons in the retina from dying and to facilitate the optimum recovery of vision after laser-mediated injury.

In this proposal, we will test whether a specific family of molecules (neurotrophic growth factors) can protect retinal neurons from dying after exposure to a harmful dose of laser energy. Neurotrophic growth factors have the capacity to bind to neurons in damaged retina and can activate genes that will promote survival of damaged cells. We will use experimental dogs in which retinal damage will be induced by exposing their eyes to laser energy. We will first investigate which particular growth factor(s) are the best candidates for neuroprotective treatment by analyzing the regulation of growth factor genes in and their tissue receptors in canine retina damaged by laser energy. After we determine the best candidate for a neuroprotective treatment, we will induce laser damage in dog eyes and treat these animals with the selected growth factors. We have developed a slow-releasing form of growth factors bound to small particles injected into the eye and that can stay active in the eye for months. We will monitor recovery of eye function (by recording electrical signals given off by the eye and pupil movements in response to visual stimulation) and structure in experimental animals with identical instruments which are used in humans. This will allow us to determine whether similar treatment could be successfully used in human patients after laser injury.

If our approach is proven successful, an injectable product with neuroprotective capabilities could be developed within 1-2 years that could be used for a rapid treatment of injured military personnel or civilians exposed to a harmful dose of laser energy. Such a product may also prove useful for reducing damage from other intrinsic causes of damage to the eye, such as glaucoma and diabetes.

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