Improving Viability and Functional Outcome After Whole Eye Transplantation

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PUBLIC ABSTRACT

Eye injuries and other problems with vision from combat trauma affect 16% of all Wounded Warriors from Operations Iraqi Freedom (OIF), Enduring Freedom (OEF), and New Dawn (OND), and rank fourth among all injuries to active duty soldiers. In addition, in present warfare 40% of blast injuries as of July 2009 resulted in injuries to the eye from blast-induced pressure waves, blunt force, and penetrating mechanisms. These injuries to the eye often result in poor vision or blindness for which there is no treatment. Wounded Warriors are left with the inability to return to work, a huge decrease in quality of life, and a dependency on caregivers. The medical and military communities can incur large expenses from the medical and social care that is needed to help these soldiers that suffer blindness from combat.

Blindness from trauma to the eye cannot be cured because of damage to the optic nerve, which is the nerve that contributes to the ability to see. It is part of the central nervous system. Unlike nerves in the hands and legs, the optic nerve does not have the ability to repair itself after it is injured. The goal of our research is to reverse blindness that occurs in Wounded Warriors through the study of whole eye transplantation (WET). Similar to face and hand transplants that have been performed throughout the world, whole eye transplant restores form and function by giving tissue from a cadaver donor. WET also gives the potential to provide viable retinal ganglion cells, the cells, which carry visual information from the eye through the optic nerve to the brain. We also propose to include nerve wraps around the optic nerve of transplants that are made of fetal optic nerve tissue. These nerve wraps will likely enhance the ability of the optic nerve to regenerate and could reverse the permanent nature of blindness.

There has been difficulty in establishing a consistent small animal model for the use of basic science research in WET. Many cold-blooded animal models have been used for research, but there have been few successful warm-blooded animal models. We previously established and published a functional face transplant model in the rat and have recently expanded our model to include the whole eye. Our WET model provides the ability to obtain high quality information in carefully designed experiments. We will examine viability, function, and the immune response after whole eye transplantation. The knowledge gained from our research has the potential to reach millions of civilians and veterans suffering from blindness by initiating the steps to make WET a clinical reality.

The high-quality basic science data from the proposed research will provide the foundation for further studies and for experiments in large animal studies that will be the stepping-stone for preclinical trials. Our timeline to large animal studies is 1 year, after the completion of the proposed research. The knowledge gained from our research has the potential help Wounded Warriors suffering from blindness regain independence, a better life and feel "whole" again.