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Retinal Detachment Repair Without Tamponade by Thermofusion of the Retina and RPE for Rapid Vision Restoration and Safe Air Transport

Principal Investigator: HERIO, WILSON J
Institution Receiving Award: CENTRE FOR EYE RESEARCH AUSTRALIA LIMITED
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View Technical Abstract
Objective: To refine a new laser treatment protocol and device for retinal detachment repair (termed "retinal thermofusion") without intraocular gas support, which will permit urgent aeromedical evacuation of military Service members.

Rationale: The retina is the film-like, light sensitive nerve tissue within the eye. When a retinal tear develops, the retina separates from underlying retinal pigmented epithelium -- similar to an inner tube collapsing inside a tyre. For over a century, surgery for retinal detachment has deliberately induced an "injury" to the retina and retinal pigment epithelium and relied on a gas bubble to hold both tissues together -- like stitches in a wound. The gas badly blurs vision and prevents flying for about 2 weeks postoperatively because the gas bubble pressure would dramatically increase during flight resulting in total blindness.

Surgery removes most of the fluid before laser treatment to seal the retinal tear but a microscopic layer inevitably remains. Consequently, laser heats the pigment cells directly, but heats the retina indirectly via the fluid separating the tissues in the same way as cooking eggs in a pan -- if eggs are separate when heated, they will cook independently, but if they are touching prior to cooking, they fuse and become inseparable.

Our preliminary experiments in mammalian eyes have demonstrated that removing the fluid prior to laser heating brings both tissues in contact so they become integrated when heated; the retina can be "spot welded" to the underlying tissue intraoperatively simply by removing the water between the retina and the pigment tissue prior to laser.

This project will determine the optimal technique for retinal thermofusion including removal of all the subretinal fluid, the optimal temperature for fusion, and refinement of a unique heating laser probe, which will attach to existing surgical systems and facilitate simpler surgery. The retinal attachment strength after laser using traditional techniques versus retinal thermofusion will be compared to definitively demonstrate the advantages of our approach. Clear clinical guidelines will be established for surgeons to obtain consistently successful results.

Applicability and Potential Impact: Retinal detachments occur in between 6.3 and 17.9 per 100,000 people (higher in short-sighted people). The retinal thermofusion technique offers advantages to all patients with retinal detachment in particular, those with inferiorly located retinal tears. It provides prompt restoration of binocular vision, improved independent mobility and permits flying in the immediate postoperative period. Estimated current annual total of vitrectomies performed globally for retinal detachment is approximately 4.5 million. This is expected to rise to 4.9 million by 2020.

The procedure carries no inherent risks beyond those associated with current surgical intervention. The simple modification to the current surgery technique can be adopted by all retinal surgeons without significant retraining or purchase of complex, costly new equipment. Following completion of this project the new laser probe registration with the US Food and Drug Administration and/or European Regulators could be complete within 12 months. It is likely that the probe will be licensed for manufacture by one of the ophthalmic medical device manufacturers for sale through existing distribution networks. Most importantly, the new retinal thermofusion technique enables immediate aeromedical evacuation post-surgery; vital in combat zones where military Service personnel need to be urgently repatriated for medical treatment and rehabilitation.
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