Vision Research Meeting Battlefield Needs: Corneal Wound Sealing/Healing and Protection

On February 18, AEVR’s *Decade of Vision* Initiative sponsored a Congressional briefing to describe research that addresses the devastating nature of traumatic eye injuries being experienced by the nation’s troops in Iraq and Afghanistan.

Colonel Donald Gagliano, M.D., M.H.A., who commanded troops in the early years of Operation Iraqi Freedom, provided an initial description of how traumatic eye injuries are diagnosed and treated in battlefield conditions. Col. Gagliano serves as the Director of the Vision Center of Excellence (VCE), a joint Department of Defense (DOD) and Department of Veterans Affairs (VA) initiative with the primary task of coordinating the Defense and Veterans Eye Injury Vision Registry (DVEIVR). Short-term, with more complete data on eye injuries, the VCE can update in-theater vision protocols to ensure early intervention to avoid ocular cell death. Long-term, the registry can identify the most significant future research needs. The VCE is coordinating with an existing civilian eye injury registry to ensure that what is learned from treatment and research is shared broadly.

Featured speaker Irene Kochevar, Ph.D., (Wellman Center for Photomedicine, Massachusetts General Hospital), who is a photochemist, described herself as a basic researcher who has focused on the light activation of tissue sealing agents. After consulting with clinical ophthalmologist Colonel Anthony Johnson, M.D. (Ophthalmology/Cornea Service, Brooke Army Medical Center, San Antonio, Texas), the pair combined their skills to submit and receive jointly an Advanced Technology/Therapeutic Development Award from the DOD’s Deployment Related Medical Research Program (DRMRP) to study the sealing of penetrating eye injuries using photo-activated bonding, as well as a joint DOD Peer Reviewed Medical Research Program (PRMRP) Translational Research Award to study corneal protection in burn patients.

Dr. Kochevar, who has studied photochemical tissue bonding on skin and peripheral nerves, tendons, and blood vessels in animal research, emphasized its benefits for wound sealing and healing in that it is sutureless, thereby reducing inflammation and scarring; creates a water-tight seal, which guards against fluid loss and infection; and is simple and rapid, with potential direct battlefield application. In summary, a non-toxic, non-inflammatory Rose Bengal dye is applied to lacerated or damaged tissue, a light source is applied (green laser or LED), and the tissue is sealed. The activation of the dye, which is already Food and Drug Administration (FDA)-approved for diagnostic purposes, promotes linking of the collagen fibers, which she describes as “nanosutures.”

In the DRMRP awards, the researchers are directly applying this technology to the sealing and healing of wounds to the cornea, especially to ensure its continued transparency, as well as to the sclera, the white part of the eye, and eyelid lacerations. For more complex, penetrating eye wounds, Dr. Kochevar seals amniotic membrane over the cornea, similar to a patch on a tire. The membrane, which is the innermost layer of the placenta, has numerous benefits in that it has a high collagen content that promotes nanosuture cross-linking, it is already used in corneal surgery, and it contains healing properties.

Building on the initial research into the membrane patch, in the PRMRP awards, the researchers are studying how it can be made stronger to create a long-lasting protective eye covering in patients who cannot blink due to scarring after burns and grafts that cause skin contraction around the eyes. Current treatments include eye drops and an amniotic membrane ring, but the latter is often degraded by enzymes in the eye within a day or two. The researchers are studying how to fortify the membrane patch by photo-bonding multiple layers of the amnion together to create a highly cross-linked structure which is more resistant to degrading enzymes.

In both sets of these animal studies, the researchers are looking at multiple variables, such as amount of dye and efficacy of light source, to determine optimal sealing and healing conditions and their relationship to a battlefield application. Dr. Kochevar estimates that the research could be ready for human clinical trials within a year, but that separate, additional funding would be necessary.

See back page for details about PRMR-Vision funding

**This corneal sealing research could be ready for human clinical trials within a year. – Dr. Kochevar**