

Study will help prevent infections following corneal transplant

Over 40,000 cornea transplantations are performed annually in the U.S., and well over 90% successfully restore vision. Because there is no synthetic material that will serve as a substitute for human corneal tissue, patients with eye injuries or diseases of the cornea depend upon donations to eye banks for healthy corneal tissue. The handling and storage of human tissue is extremely important to eye banks.

The Midwest Eye Bank and Transplantation Center has funded a study by Dr. Elmer Tu, assistant professor and director of the Cornea Service, that will determine the effectiveness of adding antibiotic vancomycin to the current corneal tissue storage medium in stopping the growth of bacteria resistant to other antibiotics. Vancomycin may reduce contamination by the resistant organisms, which should lead to a decrease in post-transplant infections, primarily endophthalmitis. While rare, this infection can lead to blindness.



Elmer Tu, MD

New finding challenges traditional assumptions about retinal degenerations

Strategies for treating patients with photoreceptor degenerations are usually based on the assumption that retinal cells beyond the photoreceptors maintain their normal function. Dr. Kenneth Alexander, Marion H. Schenk, Esq., Professor of Ophthalmology and Visual Sciences, is investigating this assumption in patients with retinitis pigmentosa (RP), one of the most common forms of hereditary retinal degeneration. The research, funded by the National Eye Institute, has important implications for therapeutic strategies that assume retinal processing beyond the photoreceptors is normal in RP.

The visual process begins when specialized cells in the retina, called rods and cones, absorb light. These photoreceptor cells are connected to many other types of neurons in the retina that carry

the visual message to the optic nerve, and then to the visual cortex in the brain. In retinal degenerations such as RP, the light-sensitive photoreceptors are the primary target of the disease.

Using novel electrophysiological procedures, Alexander, who is also the director of the Laboratory of Clinical Psychophysics, has discovered that female carriers of X-linked RP, a particularly severe form of this disease, have damage to a specific class of postreceptor neurons within the retina called ON bipolar cells. He is currently investigating whether patients with other genetic forms of RP show evidence of damage to this type of cell.

Improved imaging, diagnoses of retinal diseases is researcher's goal

How do imperfections in the optics of the human eye that limit a person's ability to view the world also create problems for ophthalmologists who must examine retinal tissue in order to diagnose and treat disease? This is the question being addressed by a study funded by the National Eye Institute and investigated by Dr. Mahnaz Shahidi, associate professor and director of the Applied Physics Laboratory.

To diagnose and monitor the progression of many eye diseases, ophthalmologists must obtain images and quantitative measurements of the patient's retinal tissue. Optical imperfections, namely ocular aberrations and light scatter, can interfere with obtaining high resolution images and accurate measurements.

Using a prototype optical imaging system she developed to quantitatively measure the eye's optical imperfections, Shahidi has demonstrated disease-related increases in ocular aberrations that adversely affect retinal image resolution in patients with diabetic retinopathy and retinal degenerations. Now she is developing techniques to compensate for the aberrations and increase the resolution of retinal imaging in these patients.

Shahidi also is investigating methods that will help differentiate between the influence of ocular aberrations and light scatter in reducing retinal image quality.

New project addresses problem for cataract patients who had refractive surgery

With at least 1.5 million refractive surgery procedures in 2000, and as many as 26.5 million within the next dozen years, ophthalmologists will see increasing numbers of patients with cataracts who have had their vision corrected with refractive surgery.

One unintended consequence of refractive surgery may not surface until years later, when a person who underwent the procedure develops cataracts. Cataract surgeons are finding traditional methods unreliable for determining the amount of correction needed in an intraocular lens (IOL) in patients who have had refractive surgery.

During cataract surgery, the cataractous lens is removed and an IOL is implanted. Traditionally, the surgeon uses two measurements to determine the IOL correction – the length of the eye and the curvature at the front of the eye, which ophthalmologists refer to as corneal power. These methods are proving inaccurate for patients who have undergone refractive surgery, perhaps decades earlier. In these patients, the IOL overcorrects vision, due to a variety of factors resulting from the refractive surgery that are not yet clearly understood.

The National Eye Institute has funded Dr. Charlotte Joslin, assistant professor, to develop a method for accurately estimating the degree of correction needed in these patients.

Joslin's research uses a contact lens to account for the refractive surgery effects and compares data in patients who undergo cataract surgery and also have previously had refractive surgery, to those who with normal corneas.

Researcher's discovery gets WIPO patent

The World Intellectual Property Organization has issued a patent to Dr. Deepak Shukla, assistant professor and director of the Ocular Virology Lab in the LIERI. The patent is for a discovery he made studying the molecular mechanism of virus invasion of human cells. Dr. Vaibav Tiwari, a postdoctoral research



Charlotte Joslin, OD

fellow working in his lab who contributed to the research, is also named in the patent.

Ocular herpes is caused when human eyes get directly infected with herpes simplex virus type-1 (HSV-1). Once acquired, the HSV-1 virus does not leave the body. Ocular herpes can produce a painful sore on the eyelid or surface of the eye and cause inflammation of the cornea. The less severe forms include blepharitis, conjunctivitis, and epithelial keratitis. The severest form is stromal keratitis, which causes scarring of the cornea and can lead to loss of vision and blindness.

Shukla discovered an enzyme that produces one of the receptors on the surface of ocular cells, called 3-O-Sulfotransferase. The identification of this entry point for the herpes simplex virus type-1 opens up the possibility of producing drugs that could block the receptor to prevent infection and its spread.

Interdisciplinary team examines Stargardt gene protein

Understanding how genetic mutations lead to retinal degeneration is critical for the development of experimental therapies. Dr. David R. Pepperberg, Searls-Schenk Professor of Ophthalmology, leads an interdisciplinary team of investigators at UIC and other institutions.

A number of retinal degenerative diseases, including Stargardt disease, are associated with mutations in the gene encoding for ABCA4. This protein, expressed in rod and cone photoreceptors, is believed to play a key role in the eye-tissue metabolism of retinoid, or vitamin A.

In a study employing the recently developed "paired-flash" electroretinographic (ERG) technique, the investigators compare the visual responses of rod photoreceptors of Stargardt patients to those of normal subjects to determine relationships between the protein mutations and rod function. The paired-flash ERGs record electrical responses of the retina to a sequence of light flashes of defined

intensity. The subjects' responses are analyzed to yield quantitative data on the cellular processes underlying the visual function of the rods.

A second study being conducted by Pepperberg and Dr. Nasser M. Qtaishat in the Photoreceptor Research Laboratory uses mice lacking the ABCA4 protein (abcr knockout mice) and, as controls, wildtype mice. They use a radiolabeled form of vitamin A as a tracer, to determine how the absence of ABCA4 affects the metabolic processing of vitamin A in the retina and retinal pigment epithelium. Fundamental studies of this type establish the knowledge base for the ultimate design of therapies – in this instance, for Stargardt and related retinal disease.

Stargardt disease is the most common form of inherited juvenile macular degeneration, characterized by reduced central vision with peripheral vision preserved.

Researcher discovers protein involved in visual processing

Dr. Haohua Qian, associate professor, has uncovered a protein present on the membrane

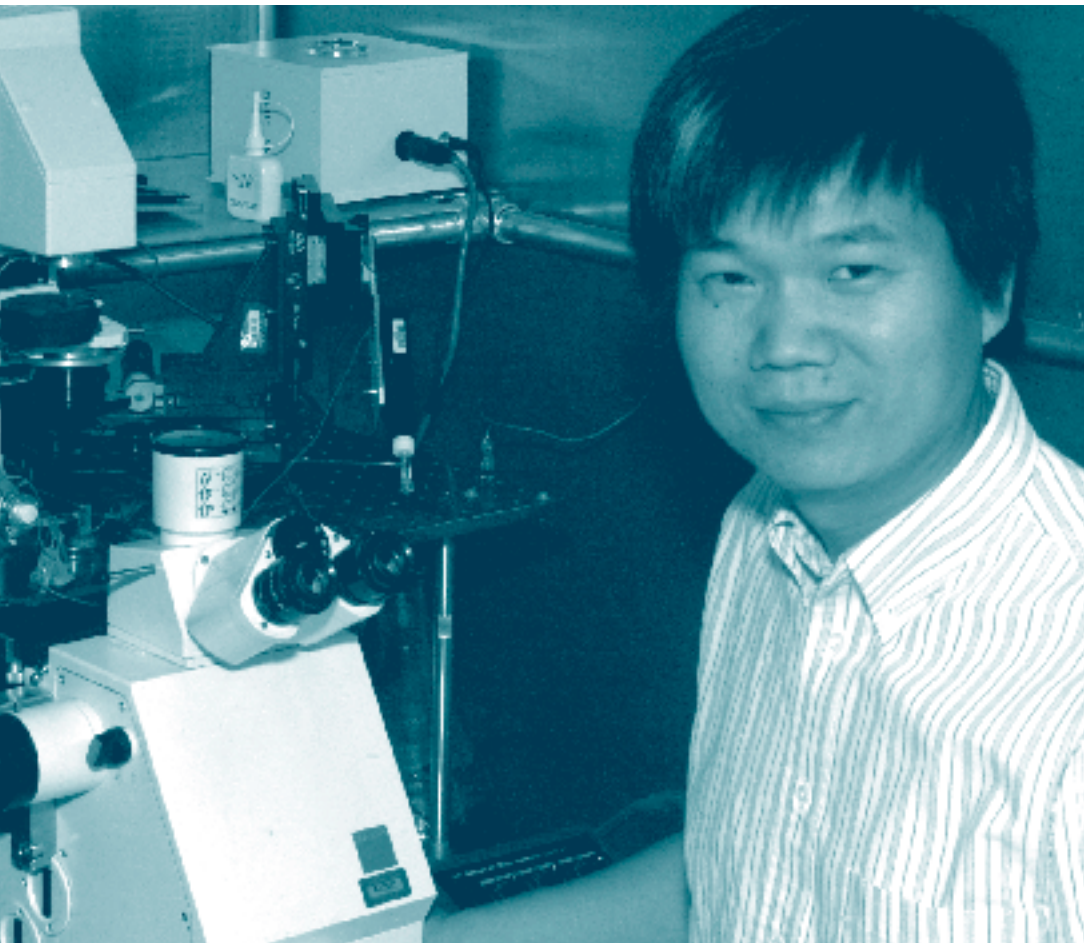
of retinal neurons. These are the nerve cells in the retina that send and receive visual messages through a combination of chemical and electrical processes. The discovery sheds light on the underlying cellular mechanisms causing a range of retinal diseases, from myopia to diabetic retinopathy.

Specifically, the Qian laboratory has identified a new type of GABA receptor in the retina. This receptor interacts with the retinoic acid system—a potent cell-signal molecule that alters gene expressions.

GABA (γ -aminobutyric acid) is a main chemical used by nerve cells to communicate with each other. GABA communication plays important roles in the central nervous system. In the visual system, GABA transmission is involved in many tasks, such as contrast enhancement and color vision.

The findings provide evidence that GABA signals could regulate long-term gene expression in the nerve cells and open a new avenue for scientists to explore links between neuronal signals and long-term gene expression in the retina.

Haohua Qian, PhD



Research to Prevent Blindness makes awards to David Pepperberg, PhD and Deepak Shukla, PhD

Research to Prevent Blindness, Inc., the world's leading voluntary organization supporting eye research, selected Deepak Shukla, PhD, assistant professor, and David R. Pepperberg, PhD, Searls-Schenk Professor of Ophthalmology, for their Career Development and Senior Scientific Investigator Awards, in 2004.

The Senior Scientific Investigator (SSI) Award honors the nation's leading vision scientists. Pepperberg's research program is laying the foundation for one day using tiny bioengineered structures to restore sight in patients with retinal degenerative diseases. These "nano" structures would bypass damaged photoreceptor cells by forming an interface with healthy nerve cells in the retina. When stimulated by light, these nerve cells would be activated, mimicking the visual signaling process and restoring sight.

Pepperberg's SSI award marks the third time since 2002 that RPB has chosen a department researcher for this award. Dr. Harris Ripps received an SSI award in 2003, and Dr. Kenneth Alexander did so in 2002. Dr. Beatrice Yue received the notable award in 1996, and Ripps first received it in 1991.

The Career Development Award to Shukla will support his ocular virology research program. Shukla is investigating virus entry into cells at the molecular level, focusing on how the human herpes simplex viruses enter into the cells of the human eye and cause potentially blinding infections. Virus entry is a complex process, in which tiny specialized viral protein "spikes" find receptors on the surface of a cell. Receptor binding launches a chain of molecular events; gaining an accurate understanding of the process holds the key to preventing this blinding disease.

Dr. Haohua Qian received a Career Development Award in 2001.