Medical Xpress

Eye muscles -- those go-getters of the anatomical world

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The eye, often called the window to the soul, may become a window to the mysteries of muscular dystrophy, a debilitating muscle disease that often leads to death in early adulthood.

Physiologists are intrigued that muscular dystrophy spares a few muscles of the body -- notably the vocal cords, some muscles of the pelvic region and the eye muscles. What is it that allows these muscles to escape the effects of this deadly disease while other skeletal muscles are so profoundly affected? At the same time, the eye muscles fall prey to diseases that do not affect other skeletal muscles. Why?

These are some of the intriguing questions that four eye muscle experts will explore at the symposium, “Ultra fast and ultra active: the strange life of the extraocular muscles.” The symposium will take place at the 120th annual meeting of The American Physiological Society (APS), which coincides with Experimental Biology 2007.

“We think that by learning what makes these muscles unique, we will understand why they are spared by some neuromuscular diseases and targeted by others,” said Francisco H. Andrade, Ph.D., who will lead the symposium. “These insights will lead, in turn, to better treatment options for these diseases.”

On the go

The extraocular muscles are the six small muscles that move each eye from side to side, up and down and on the slant. When these muscles don't work together, it can affect vision. One condition that can arise when these muscles don't work together is strabismus, a condition that affects about 5% of children and arises when the eye muscles don't work together properly. This leads to "lazy eye," in which one eye takes over all the vision duties. If strabismus is not treated, it results in functional blindness.

A defining characteristic of these tiny muscles is that they are nearly always moving, even during sleep. In fact, even when "staring" at a fixed object, the eyes keep moving over the image. Although these muscles are very small, they use a lot of energy because they are always on the go.

And that is a key to Dr. Andrade's presentation, "Always active, always hungry: the metabolic design of the extraocular muscles." The cells that make up the extraocular muscles contain more mitochondria, the energy manufacturing structures in all cells, than other skeletal muscles, such as those of the limbs. This rich population of mitochondria allows the muscles to keep moving the eye. On the other hand, this leaves the eye muscles vulnerable to diseases that target the mitochondria, such as Kearns-Sayre syndrome, a condition that gradually limits eye movements and eventually immobilizes them completely.

Dr. McLoon will discuss "Dynamic cell biology of the extraocular muscles." She looks at satellite cells, a type of cell involved in muscle growth and injury repair. The extraocular muscles are richer in satellite cells than the skeletal muscles of the limbs. There is evidence that eye muscles regenerate much faster than skeletal muscle of the limbs. This may be a key to why the eyes have a greater ability to withstand the onslaught of muscular dystrophy. Another very important aim of Dr. McLoon's research is to find new drugs to treat strabismus.

Dr. Kaminski will talk about the “Differential involvement of extraocular muscle by neuromuscular disease.” His work focuses on myasthenia gravis, an autoimmune disease which disrupts communication between muscles and nerves. The illness particularly affects the eye muscles, causing drooping eyelids and double vision. Dr. Kaminski focuses on the eye’s immune environment. He looks at what role this plays in the eye muscles’ vulnerability to myasthenia gravis. If this process can be better understood, it could eventually lead to new treatments. His research also has implications for Graves disease, an auto-immune thyroid disorder in which the extraocular muscles get enlarged causing the eyes to bulge out.

Dr. Goldberg will speak on “Eye muscle motor units: a petite illumination.” His laboratory investigates the motor neurons of the brainstem which are involved in tongue and eye movements. (When a doctor asks a patient to follow his or her finger, the patient’s brainstem functioning is being tested.) This research has applications to strabismus. When rats have strabismus, they can later recover vision in both eyes, but humans permanently lose the ability to have normal vision. This finding has been a tantalizing one for physiologists, who want to find out how rats manage to recoup their vision. The hope is to find out how this can be applied to humans.

Source: American Physiological Society