Matthew Bellassai, Biological Engineering

Year in School: Senior
Hometown: Olathe, KS
Faculty Mentors: Dr. Gang Yao, Biological Engineering and Dr. Bo Lei, Ophthalmology
Funding Source: College of Engineering Honors Undergraduate Research Option

Pupillary light reflex (PLR) as a noninvasive functional vision test

Study of visible and ultra-violet light elicited pupillary light reflex (PLR) in mice Purpose: PLR has previously been used as a functional test in animal models of retinal degeneration. We investigate the feasibility of using PLR to quantitatively examine the functionalities of rod and cone systems in mouse. Methods: Pupillary light reflex (PLR) was measured in dark-adapted C57BL mice, and aged-matched Rho-/- rhodopsin knockout mice and cfl1 cone function loss mice. Both visible (505nm) and ultraviolet (380nm) light were used in the study with intensities ranging from 7 to 16 log units of photons/s/cm2. Mice were exposed to successive 5-second stimuli of ascending intensities of light. The pupil was imaged by an infrared CCD video camera and videos were digitized at a sample frequency of 10Hz. The pupil area of each image was measured automatically using a custom compiled program. We obtained the response-intensity curve of PLR and compared them with electroretinogram (ERG) data. Results: In C57BL mice, the PLR thresholds were ~1E8 photons/s/cm2 for both UV (380nm) and visible (505nm) wavelengths. The initiation of cone response can be clearly identified at ~1E12.5 photons/s/cm2. Similar cone threshold was observed from PLRs measured in Rho-/- mice. In cfl1 mice, PLR measurements showed the same threshold as in C57BL mice; whereas the PLR became saturated at intensities larger than 1E12.5 photons/s/cm2 and cone system contribution was absent. When compared PLR response-intensity curves with the corresponding ERG curves, we found that dark-adapted ERG responses had higher thresholds than PLR. Conclusion: Our results indicate that PLR provides significant quantitative data that can be used for testing the functionality of visual systems. Cone system and rod system responses have different thresholds and thus can be assessed independently.