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View Abstract

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Study Group: (none)

ABSTRACT

TITLE: Towards visual function restoration through photoacoustic stimulation

ABSTRACT BODY:

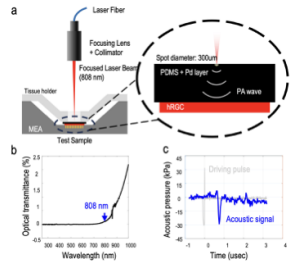
Purpose: Degenerative retinal disorders are a major public health problem, and can lead to permanent vision loss and blindness. One hope is that photoreceptor (PR) disorders with intact retinal ganglion cells (RGCs) can be treated to partially restore visual function by controlled stimulation. As one approach to achieve this goal, we are working to develop the use of photoacoustic (PA) waves to directly stimulate RGCs, in a process by which acoustic pressure generated from laser illumination interacts with the mechanosensitive channels of RGCs.

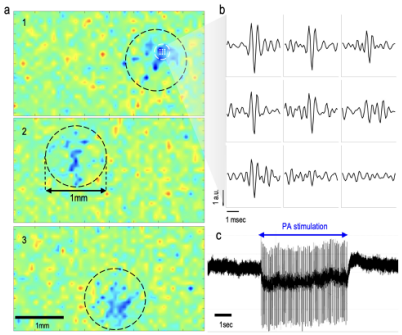
Methods: Cultured 44-day-old human-stem-cell-derived RGCs (hRGC) were excited with PA wave, which was

generated from a PA sensitive material that was placed in contact with the hRGCs. The material was illuminated by a focused laser that is below standard laser safety level (Fig 1a). Optical transmittance and acoustic pressure were measured to validate acoustic pressure is exclusively interacted with the hRGCs (Fig 1b,c). A micro-electrode array (MEA) was used to record electrophysiological activities from the hRGCs upon PA stimulation (Fig 1a). Multiple locations were selected for the stimulation, and 50 laser pulses were directed to each position at 10Hz.

Results: Fig 2 shows the MEA recording from hRGCs upon PA stimulation. Compared to the control group where the laser was excited to empty area, the hRGCs were successfully stimulated at different spots, indicating that the PA stimulation can provide spatial specificity (Fig 2(a, c)). The recordings from 9 adjacent electrodes spanning 1,225 um^2 show collective readings from a single stimulus, and the peak intensities decrease as a function of distance from the highest response at top left (Fig 2(b)). Total number of spikes were counted at different laser energy density:{1255, 819, 485, 423, 424}spikes at {16.9, 14.1, 12.7, 9.9, 7.1} mJ/cm^2, respectively. The total number of spikes decreased significantly when the laser energy density was below 12.7 mJ/cm^2, implying that determining the energy density is crucial to secure a stable stimulus.

Conclusions: In this study, we have shown that PA stimulation can be used to stimulate the hRGCs, and corresponding responses were recorded and validated using MEA. We will further optimize laser excitation parameters and PA material to obtain controlled stimulation at higher spatial resolution. We anticipate that this technology may be able to provide visual information to partially restore lost vision.





DETAILS

PRESENTATION TYPE - PLEASE NOTE, IF YOU CHANGE YOUR PRESENTATION TYPE AFTER APPLYING FOR AN AWARD (BELOW), YOU MUST GO BACK AND RESELECT THE APPLY BUTTON.: #1 Paper, #2 Poster : Travel Award Applicant

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