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Service (sector) Retina and Vitreous N° CEP

Electrical stimulation of rabbits retinas – basis for retinal stimulation in human subjects

Maurício Maia¹, Jeng-Shyong Shyu², Michel Eid Farah¹, Douglas Yanai¹ James D. Weiland¹, Eugene de Juan Jr¹, Mark S. Humayun¹ ¹ – Department of Ophthalmology – UNIFESP/EPM ² – Doheny Eye Institute/USC **Purpose:** To study stimulating current thresholds of electrically elicited retinal ganglion cell responses using two different size of stimulating electrodes on both retinal surfaces of isolated rabbits retinas in presence or absence of cadmium. **Methods:** Fifty-three isolated rabbit retinas were electrically stimulated using either 25 or 125 mm diameter needle electrodes in a bipolar configuration. Electrodes were positioned either on the ganglion cells or photoreceptor retinal surface. Penetrating tungsten wire microelectrodes were used for ganglion cells recordings. In nine of these experiments, 2mMol of cadmium was used to study the effect of this synaptic blocker on the stimulation thresholds and latency. In all experiments, the stimulation electrodes were positioned 5-6 mm inferiorly to the optic disc. Recording electrodes were placed between the optic disc and the stimulation electrodes. Distance between stimulating and recording electrodes was kept constant at 1.5 mm. A cathodic first, biphasic electrical current waveform of 1ms duration/phase was used as the stimulus in all experiments. Statistical analysis was performed by the variance ANOVA test and the non-parametric sign test. **Results:** Current intensity thresholds values ranged from 6.7 ± 4.3 mA to 18.13 ± 5.06 mA. Charge density ranged from 53.8 ± 33.05 mC/cm² to 3695 ± 1031 mC/cm² and latency ranged from 0.71 ± 0.26 ms to 1.34 ± 0.061 ms. Current thresholds were higher and latency values longer when the stimulating electrode was a 25 mm diameter electrode positioned on the photoreceptor retinal surface ($p < 0.01$). Cadmium addition resulted in shorter latency when 25mm diameter stimulation electrodes were placed on the photoreceptor retinal surface ($p < 0.01$). These findings taken together suggest selective stimulation of the outer retinal neurons by 25mm diameter electrodes placed on the photoreceptor retinal surface that is not present when using 125mm diameter electrodes. **Conclusions:** Current intensity was more important than charge density to induce electrically elicited response. Smaller electrodes did not result in lower stimulus thresholds but did result in improving selectivity of electrical stimulation. Further studies in normal non-myelinated and retinal degenerated animals are necessary to define the optimal electrical stimulation parameters for a safe retinal prosthesis.