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Anodal direct current stimulation at the eye evokes temporary variations in retinal vessel response to flicker

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Abstract

Purpose : Electrical stimulation (ES) is a recent therapeutic approach in ophthalmology that is applied to patients suffering from various retinal diseases like retinitis pigmentosa or retinal artery occlusion. Similarly, transcranial ES uses weak electrical currents to treat neurological and psychiatric disorders. The main effect of transcranial ES is the modulation of cellular activity. This study addresses the ES induced vascular processes in the retina. We tested the hypothesis that anodal direct current stimulation (DCS) at the eye evokes temporary variations in the retinal vessel response to flicker.

Methods : We studied 6 healthy volunteers (25.5 ± 2.1 years) and determined their retinal vessel responses before, immediately after and 15, 30, 45 and 60min after ES using dynamic vessel analysis (DVA). Each recording contained 50s baseline, 20s flicker and 80s post flicker recording. Retinal vessel responses were calculated as the mean of 3 averaged recordings and expressed as the stimulation induced dilation of the vessels relative to their baseline diameters. ES at the eye was applied using a new electrode montage consisting of a ring-shaped rubber electrode surrounding one eye (anode) and a cap-integrated textile electrode at the occiput (cathode). Anodal DCS (current strength: $800 \mu\text{A}$) was applied for 20min.

Each subject was examined in 2 sessions: one with active electrical stimulation (aES) and one with sham stimulation (sS). Retinal vessel responses were measured in temporal arterial and venous vessels. Wilcoxon signed-rank test was used to test for significant differences in the retinal vessel dilation for aES and sS on a level of $p=0.05$.

Results : All subjects showed physiological retinal vessel responses. Arterial / venous dilation was $3.8 \pm 1.6\%$ / $4.5 \pm 2.4\%$ before aES and $3.6 \pm 1.6\%$ / $3.9 \pm 1.3\%$ before sS. Maximum difference between aES and sS was observed immediately after ES: venous vessel dilation was significantly increased for aES ($5.9 \pm 2.0\%$) compared to sS ($4.2 \pm 2.2\%$); the difference in arterial vessel dilation was at trend level (aES: $4.4 \pm 1.0\%$; sS: $3.5 \pm 1.1\%$). Up to 60min after ES the difference in dilation for aES and sS regressed.

Conclusions : The results show an influence of ES on retinal vessels and DVA is a suitable tool to observe these variations. The hypothesis that anodal DCS provokes temporary aftereffects regarding vascular processes in the retina is confirmed.

This is an abstract that was submitted for the 2016 ARVO Annual Meeting, held in Seattle, Wash., May 1-5, 2016.

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