

An abnormal transduction of the chromatic stimuli from the outer to the inner retinal layers may contribute to cause photophobia in migraine

Gianluca Coppola¹, L. Corso², A. Di Renzo¹, A. Fadda³, F. Martelli³, C. Di Lorenzo⁴, V. Parisi¹, J. Schoenen⁵, B. Falsini⁶, F. Pierelli².

1. G.B. Bietti Foundation IRCCS, Department of Neurophysiology of Vision and Neurophthalmology, Rome, Italy
2. "Sapienza" University of Rome Polo Pontino, Department of medico-surgical sciences and biotechnologies, Latina, Italy
3. Istituto Superiore di Sanità, Dipartimento Tecnologie e Salute, Rome, Italy
4. Don Carlo Gnocchi Onlus Foundation, Milan, Italy
5. Headache Research Unit, Department of Neurology-CHR Citadelle, University of Liège, Belgium
6. Catholic University of S. Cuore, Rome, Italy

BACKGROUND

Subtle impaired macular vision was observed among different psychophysical experimental tasks in migraine (Shepherd, 2005).

Photophobia, i.e. the clinical hypersensitivity to environmental light stimuli, is reported in most all forms of migraine and many neuro-ophthalmic disorders. It is included as one of the major criteria for migraine in the International Classification of Headache Disorders. During the last years, the mechanisms underlying photophobia were the subject of an intense scrutiny.

Recent experimental evidences point out a possible involvement of outer and inner retinal layers in hypersensitivity of migraine patients to light stimuli.

OBJECTIVE

To investigate the short-wavelength-sensitive (S) and the medium/long-wavelength-sensitive (ML) cone photoreceptors of the visual pathways in migraine without aura (MO) patients between attacks and in healthy volunteers (HV) by using yellow-blue (Y-B) or red-blue (R-B) visual flicker stimuli.

DESIGN & METHODS

Square-wave focal electroretinograms (FERGs) were recorded in 22 MO patients and 20 HV. For each randomly presented flicker stimulation protocol (Y-B or R-B), 600 sweeps (4Hz repetition rate) were recorded and partitioned in 6 blocks of 100. Fourier analysis allowed extracting from the FERG data the fundamental (1F) and the second harmonic (2F) components (amplitude and phase) that are related respectively to outer and inner retinal activity. Usual headache severity and photophobia during migraine were scored on a 0 to 10 visual analogue scale.

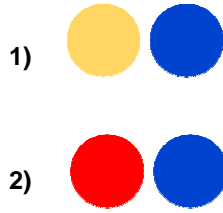
RESULTS

When compared to HV, MO patients had an advanced 1F phase but normal amplitude in all blocks of Y-B FERG. In MO patients, the self-rated intensity of ictal photophobia was positively correlated with attack frequency ($r=0.571, p=0.01$), headache severity ($r=0.508, p=0.03$), 1F Y-B phase (all blocks $r=0.487, p=0.04$), 1F R-B phase ($r=0.521, p=0.03$), 2F Y-B amplitude (all $r=0.610, p<0.01$), habituation slope ($r=0.686, p<0.01$), and 2F R-B phase ($r=0.526, p=0.03$).

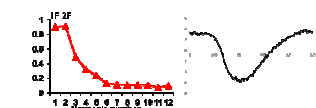
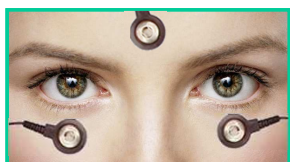
DISCUSSION

These results suggest that an abnormal signal transduction from the outer to the inner retinal layers could contribute to the mechanisms by which light causes pain or discomfort during the migraine headache.

Procedure



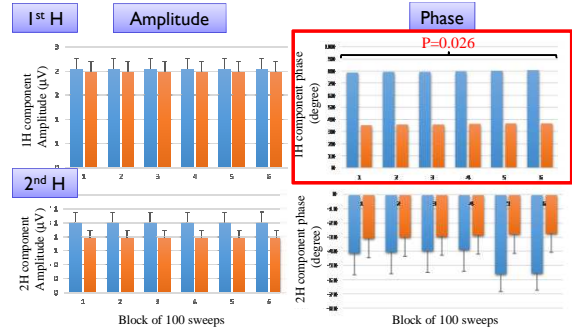
Two stimulus protocols were randomly presented by means of a Ganzfeld: yellow-blue (Y-B, 1) and red-blue (R-B, 2) visual flicker stimuli, investigating short- and medium/long- wavelength-sensitive cone photoreceptors of the visual pathway.



✓ 600 sweeps: 6 blocks of 100

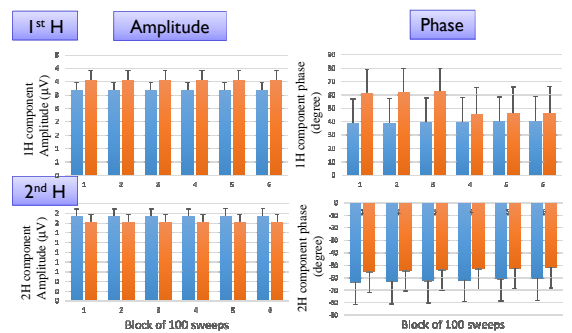
✓ Fast Fourier Transformation = amplitude and phase

FERG yellow-blue



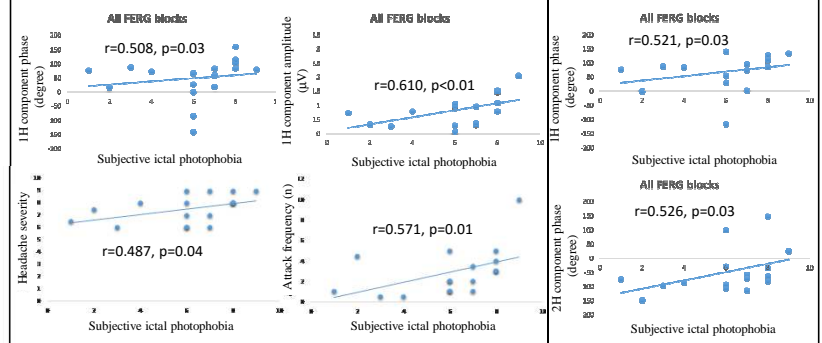
When compared to HV, MO patients had an advanced 1st Harmonic (H) phase but normal amplitude in all blocks of Y-B FERG

FERG red-blue

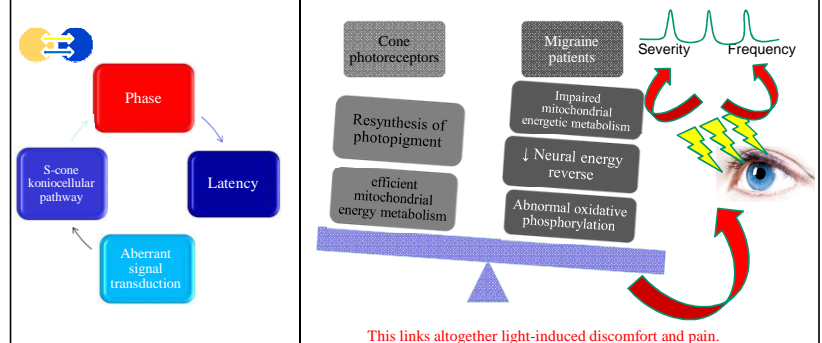


1st and 2nd harmonic (H) amplitude and phase did not differ between groups in all blocks of R-B FERG

Correlations



Conclusions



This links altogether light-induced discomfort and pain.

REFERENCES

- Shepherd AJ. Colour vision in migraine: selective deficits for S-cone discriminations. Cephalalgia 2005; 25:412-423.