64A

144

THRESHOLD VALUES FOR MAGNETO- AND ELECTROPHOSPHENES - A COMPARATIVE STUDY.

[redacted]

It has been known for a long time that low frequency, transient magnetic fields and electric currents of moderate strengths generate visual phenomena called phosphenes. Several authors have studied the threshold values for electro- or magnetophosphenes. However, the two phenomena have never been compared under identical experimental conditions.

In this work we have compared the threshold value curves of the two different ways to induce phosphenes. The threshold values are determined at a luminance level on the eye of 3 cd/m^2. We have used both broad spectrum light and light with the wavelength 572 nm as background illumination. At the two types of background illumination the two threshold curves are nearly identical up to a magnetic field frequency of about 20 Hz, but for higher frequencies they are diverging. The threshold curves for magnetophosphenes have a local sensitivity minimum at 30-35 Hz, which is missing in the electrophosphene curves. The preliminary results indicate that principal differences exist between an electric current and a magnetic field in the generation of phosphenes.

Phosphenes induced by electric currents or time-varying magnetic fields have been described in a qualitative manner by several authors. Most of the work has been done on the nature of electrophosphenes. However, very few quantitative studies of these phenomena have been carried out. No attempt has been made to investigate if the two types of phosphenes are generated by the same physiological mechanism or not.

A comparison between threshold curves of the two types of phosphenes can further increase our knowledge of the mechanism behind the interaction between the magnetic field and excitable tissue.

Method

A group of ten visually normal volunteers were partly exposed to a low frequency magnetic field and partly stimulated with an electric current (via skin electrodes) with a varying frequency, 10-50 Hz. The magnetic flux density was in the range 0-40 mT and the current strength was 0-0.3 mA. Threshold values for the magneto-/electrophosphenes were determined under variation of the magnetic flux density/electric current at frequencies in the interval 10-50 Hz. The threshold values were determined at a luminance level on the eye of 3 cd/m^2 partly with a broad spectrum light and partly with the wavelength 572 nm of the background illumination.

On another group of volunteers we determined the threshold values for the electrophosphenes at three different electrode sites (3 cd/m^2, broad spectrum light) in order to evaluate the influence of current direction on the visual response.

Results

The threshold values for the two types of background illumination was determined. In fig 1 the normalized threshold values of the magnetic flux density/current as a function of the frequency of the magnetic field/current is illustrated.

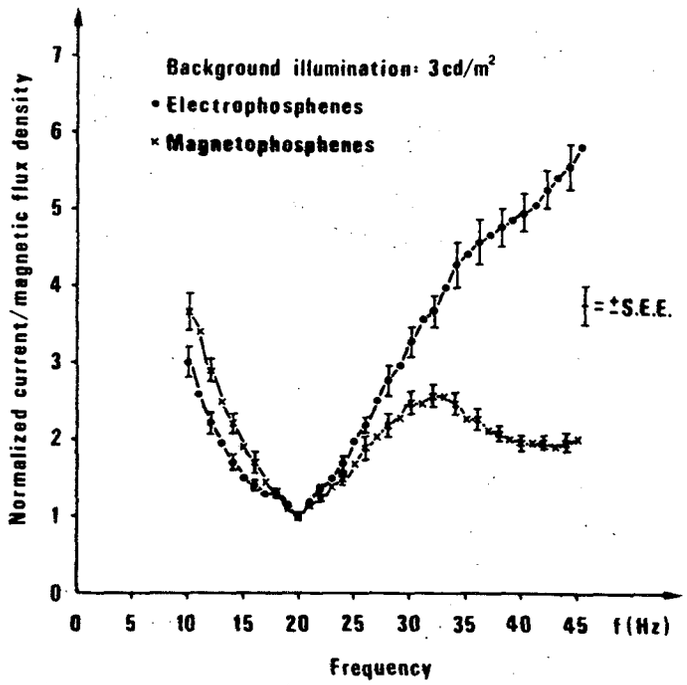

Fig 1. Magneto/electrophosphene threshold curve at 3 cd/m^2, broad spectrum light, 10 volunteers.

At both types of background illumination the threshold curves were nearly identical up to about 20 Hz, where a marked sensitivity maximum is reached. For higher frequencies the curves diverged. The threshold curves for magnetophosphenes showed a local sensitivity minimum at 30-35 Hz, which is missing in the electrophosphene curve.

The local sensitivity minimum could not be found with electrical stimulation in any of the three electrode sites.

The preliminary results indicate that principal differences exist between an electric current and a magnetic field in the generation of phosphenes.

References

Lövsund, P., Öberg, P.Å. and Nilsson, S.E.G.: Quantitative determination of threshold values for magnetophosphenes. 1977 International Symposium on the Biological Effects of Electromagnetic Waves. Airlie, Virginia, U.S.A. (accepted for publication in Radio Science).

Acknowledgements

This study has been sponsored by the Swedish Work Environment Fund, No 77/172 and 77/172:2.