Effect of a Pulsed Magnetic Field and of First Cold-Pressure Sunflower Oil on Mice

André Bellossi*, Chantal Rocher and Michel Ruelloux

Laboratoire de Biophysique. Faculté de Médecine, 2 Avenue du Pr. Léon Bernard, 35043 Rennes Cedex France. Fax: (33) 2 99 33 68 42. E-mail: bellossi@univ-rennes1.fr

* Author for correspondence and reprint requests

Z. Naturforsch. **55 c,** 267–270 (2000); received September 20, 1999

Magnetics Fields, Mice, Sunflower Oil

In previous studies it has been shown that exposure of mice to a 12-Hz 6 mT unipolar square pulsed magnetic field (PMF) suppressed the excess of weight due to application of 1st cold-pressure sunflower oil. This time we considered the effect of oil and/or PMF on the growing curves lifespans of mice. The exposure took place for 30 min 5 days a week, from the 7th week of life to death. The results are 1) a broken slope in the growing curves from the 125th day of aging: the exposed mice were lighter than the controls, keeping the differences between the growing curves needed a repeated exposure all life long; 2) a significant increase in the lifespan of the controls which received oil versus the controls which received water; 3) an increase in the lifespan of the exposed mice versus the non-exposed control batches. On one hand it has been reported that essential polyunsaturated fatty acids found in first cold-pressure sunflower oil played a prominent role in membrane structures and in immune equilibrium. On the other hand, it was shown that oscillating electric fields could activate Na^+,K^+-ATPase.

Introduction

In previous studies (Bellossi and Rocher, 1995; Bellossi *et al.*, 1997) we have shown that exposure of mice to a 12 Hz pulsed magnetic field (PMF) suppressed excess of weight due to application of first cold-pressure sunflower oil. In a seminal study, Kousmine related the positive effects of first cold-pressure sunflower oil upon mice (Kousmine, 1987). Our experiment was carried out to check the findings of Kousmine and to look for an effect of PMF on the lifespan of mice with and without oil application.

Material and Methods

Swiss female mice (Etablissements JANVIER, Le Genest, France) were used. They were brought into the laboratory at the age of 6 weeks. The experiment began one week later. The temperature in the laboratory was 20 °C and natural light was maintained throughout the experiment. Fifty-three mice were used as controls, 49 were exposed to a PMF. Water and food (Usine d'Alimentation Rationnelle. Paris, France) were given *ad libitum*. Each week the weights of food consumed among the different sets of mice were measured. Moreover, 26 controls and 23 exposed mice received 0.1 ml of first cold pressure sunflower oil (Provence-Régime, Pont Saint-Esprit, France) *per os* for 5 consecutive days each week whereas 27 controls and 26 exposed mice received 0.1 ml of water. Analysis of the oil has shown (g/100 g): 1) satured fatty acids: palmitic C16:0 6.5, stearic C18:0 4.5, arachidic C20:0 0.2; behenic C22:0 0.72) unsaturated fatty acids: palmitoleic C16:1 0.1, oleic C18:1 26.1, linoleic C18:2 60.9, linolenic C18:3 0.4, ecosenoic C20:1 0.5. 3) α-tocopherol 0.052.

The PMF generator was a Magnobiopulse apparatus (Société ATLAS, Paris, France). The signal consisted of series of unipolar square pulses which had a repetition frequency of 12 Hz. The repetition frequency of pulses in the train was 85 kHz. There were between 6 and 9 pulses in each train according to the generator. The generator had 4 flat coils, each 40 mm in diameter. The center of the 4 coils was put on a circle of 6 cm in diameter. The 4 series-wound coils were embedded in a flat plastic disc 12 cm (diagram 1). The peak field strength, at the surface of the disk was 6 mT. Each generator consisted of 2 disks.

For the exposure phase, the plastic (altuglas) containers were divided into 29×29×100 mm compartments, each housing one mouse. The discs were placed on top of a container (diagram 2). The

0939–5075/2000/0300–0267 $ 06.00

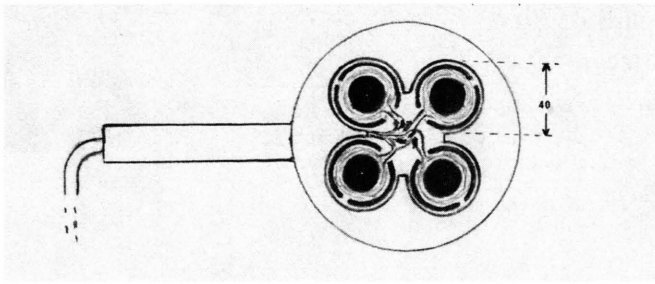

Diagram 1.

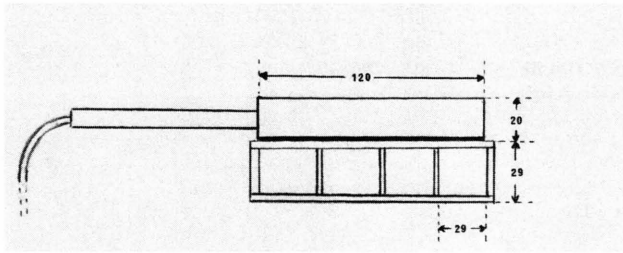

Diagram 2.

controls were put into the container without the introduction of any field energy. The exposure took place for 30 min 5 days each week from 6 weeks of age until the time of death. One group of 5 mice which received oil was exposed until the 172nd day of age when exposure was stopped. The mice were weighed twice each week. When the mice were dead, their brains, lungs, hearts, livers, spleens and kidneys were weighed (Mettler H 10T balance).

Results

Growing curves

The moving averages of weights were computed for five consecutive data. The growing curves were taken into consideration up to the 400th day of age only to avoid the irregularities due to the death rate. The results are shown in Fig. 1A. Two sets are obvious: the controls and the exposed mice. There were no differences according to oil or water. The slopes of the growing curves of the two sets were the same until about 125 days of age, then the controls proved heavier than the exposed mice. The difference between the weights increased until about the 280th day of age. After this time, the growing curve of the mice which were exposed until the 172nd day of age caught up to the growing curve of the controls (Fig. 1B). The weights of food consumed each week by the 4 sets of mice are shown in Fig. 2. The weight of food consumed by the mice of a set was divided by the number of mice and a moving average over 4 weeks was computed. The mice which received oil and were exposed to the PMF ate less than the other mice ; the differences with the mice of the other sets were more obvious in and after the 24th week.

Lifespans

The average survival times (with standard deviations) are given in Table I. The survival curves of mice of the two control sets, one of which received water and the other one oil, are shown in Fig. 3. According to the Logrank test, the difference is significant ($p = 0.0339$). The gain in longevity of the mice receiving oil is 96 days, that is almost 20%.

Weights

There was no significant difference between the average weights of the organs (brains, lungs, hearts, spleens, kidneys, livers) at death (ANOVA test).

Discussion

Inexplicably, the growing curves of the mice which were not exposed were not different

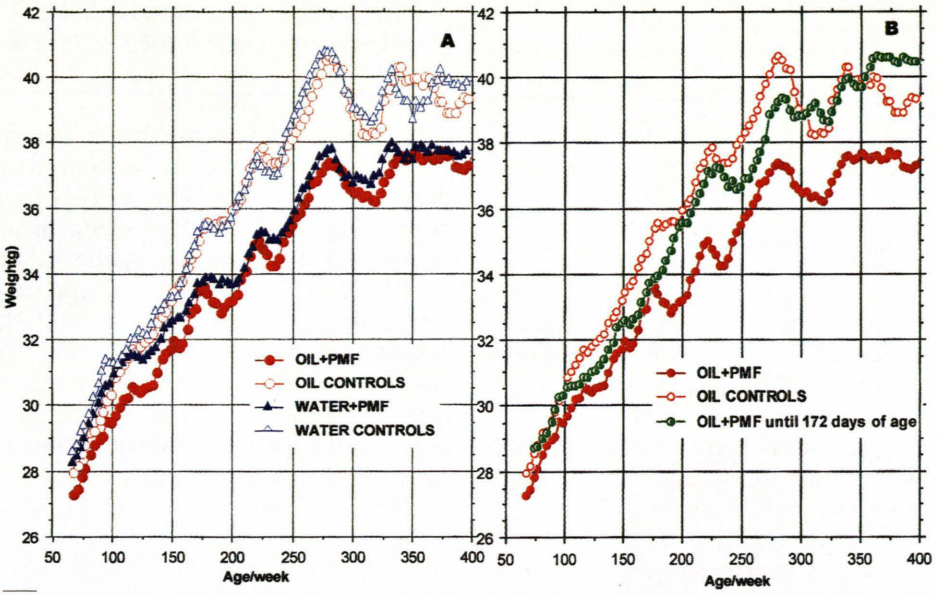

Fig. 1. Average growing curves – A: the 4 sets of mice; B: mice receiving oil according to the length of exposure.

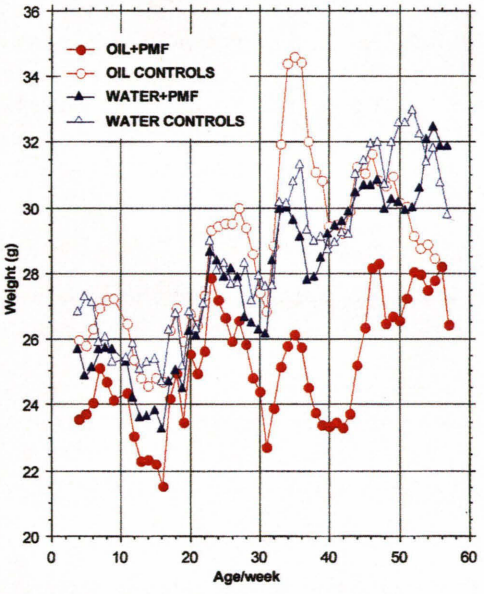

Fig. 2. Weights of food consumed each week by the 4 sets of mice.

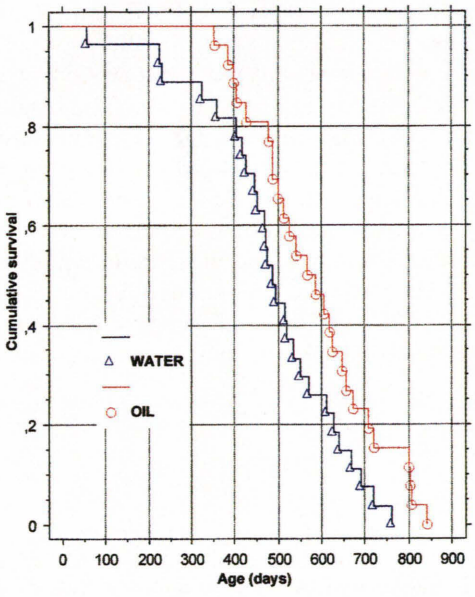

Fig. 3. Kaplan-Meier cumulative survival graph for the control mice.

whether the mice received either oil or water. But this experiment corroborates previous results (Bellossi and Rocher, 1995): the exposure to the 12 Hz PMF broke the growing curves after about 4 months of age. The difference in weight required the maintenance of the exposure sessions throughout the lifetimes of the mice. A break in the growing curve is first considered as a harmful effect. However, the observation of the mice did not confirm that assumption and the exposure of the mice

Table I. Mean survival times (with standard deviations) of the different sets of mice in days.

Controls		Exposed mice	
Water	Oil	Water	Oil
488 ± 31 n = 27	584 ± 28 n = 26	523 ± 37 n = 26	549 ± 23 n = 23

n = numbers of mice in the sets.

which did not receive oil resulted in an increase in their lifespan. Moreover, no specific difference in the organs was observed at death according to exposure or not.

The consumption of food showed that the relative overeating of mice which received water and were exposed to PMF was of no consequence with regard to weight gain. On the other hand, the adult exposed mice which received oil required less food, which is in favor of an effect of PMF.

However, receiving the oil was propitious as far as the lifespans were concerned. So it can be considered that the exposure to PMF improved metabolism. The energy brought by the oil input was taken into account and the consumption of food decreased. According to Kousmine, the beneficial effect of first cold-pressure sunflower oil is due to its high rate in essential polyunsaturated fatty acids, linoleic and linolenic acids (Kousmine, 1987). Linoleic acid plays a prominent role in membrane structures and in immune equilibrium. The 12-Hz PMF had a similar effect as the first cold-pressure sunflower oil on how long the life lasted. A normal plasma membrane gives rise to a definite membrane potential linked to different ionic concentrations on the two faces of the membranes. Ions go passively across the membrane according to ionic gradients.

Goodman demonstrated that exposure to ELF electromagnetic fields, under conditions of amplitude, frequency and time, caused transcriptional changes in HL 60 cells (Goodman and Shirley-Henderson, 1990) (Lin *et al.*, 1993). According to Guillé (1983), metals such as copper, iron, zinc, mercury, gold, silver, can be linked to DNA in the constitutive heterochromatin. That binding induces an alteration of the structure of a part of DNA molecules. In that way, these metals interfere in the processes of regulation which are in correlation with physiological and/or pathological events. Now, computation shows that such ionized metals are able to react when they are exposed to an electromagnetic field with a 12 Hz repetition frequency (Bellossi *et al.*, 1997). Setting these ions in motion would allow them to shift from an abnormally unsteady position to a fundamentally stable state. Thereby the operating lever of cells would be kept in good conditions. Agressions throughout the lifespan cause repetitive perturbations of DNA structure. So, exposure must be repeated to correct the induced trouble. The final result would be a better metabolism and a gain in lifespan.

Acknowledgements

We thank MC Hazard from the laboratory of Biophysics of Rennes for her technical collaboration.

Bellossi A., Dubost G. and Himdi M. (1997), Effets biologiques du champ électrique et du champ d'induction magnétique aux très basses fréquences. Revue Scient. Techn. Défense, **4**, 83–96.

Bellossi A. and Rocher C. (1995), Growing curves of mice receiving sunflower oil. Effect of pulsed magnetic fields. Bioelectromagnetics Society, 17th Annual Meeting, Boston, Abstract book 14–6.

Goodman R. and Shirley-Henderson A. (1990), Transcriptional changes in HL 60 cells exposed to ELF electromagnetic fields, 12th Annual Meeting Bioelectromagnetism Society, Abstract book G. 1–5.

Guillé E. (1983), In: L'alchimie de la Vie. Biologie et Tradition. Du Rocher Publ. (Monaco), 57–67.

Kousmine C. (1987), Sauvez votre corps! Robert Laffont Publ. (Paris).

Lin H.-I, Goodman R. and Shirley-Henderson A. (1993), The role of transcriptional regulation in the response of cells to EM fields. Bioelectromagnetics Society, 15th Annual Meeting, Abstract book C. 2–3.

Tsong T. Y., Liu D. S. and Chauvin F. (1989), Electroconformational coupling (ECC): an electric field induced enzyme oscillation for cellular energy and signal transduction. Bioelectrochem. and Bioenerg. **21**, 319–331.