A REVIEW OF THE POSSIBLE EFFECTS OF 50/60 HZ ELECTRIC AND MAGNETIC FIELDS ON MELATONIN SECRETION

Jacques LAMBROZO[1]

1. EDF-GDF Service des Etudes Médicales. Paris

INTRODUCTION

The possible relationship between exposure to extremely low electric and magnetic fields (EMF) and biological effects has become a public concern and a very active research topic. Many in vitro and in vivo studies have been carried out to explore the possible mechanism by which those fields can influence the fonctionning of living cells and whole animals. One of the ways in which electric or magnetic fields may effect animals and men is via melatonin.

ANIMAL DATA

***In Rodents**:*

Electric fields: three kinds of reactions to 60 - Hz electric field have been described: reduction of pineal melatonin synthesis (1), reduction of serum melatonin due to an increase of degradation or of tissue uptake of melatonin (2), absence of effect of chronic exposure (3).

Magnetic fields:

	SPECIES	FIELD	FREQUENCY AND ORIENTATION	DURATION	EFFECT
YELLON (4)	Adult Djungarian hamsters (male and female)	100 µT	60 Hz	15 min 2 hours before darkness 'long days'	. 1st experiment January - Nocturnal melatonin rise in pineal and serum: delayed - Nocturnal peak: shifted and blunted . 1st replicate (6 months later) June - Nocturnal melatonin rise in pineal and serum: reduced - Nocturnal peak: blunted . 2nd replicate January - No statistical differences between control and exposed hamsters
YELLON (5)	Djungarian hamsters (male and female)	100 µT	60 Hz	15 min 2 hours before darkness 'short days'	. Nocturnal melatonin rise in pineal and serum: delayed
WILSON (6)	Djungarian hamsters	100 µT	60 Hz	15 min 2 hours before darkness	. Nocturnal pineal melatonin rise: decreased . Medial basal hypothalamus norepinephrine: increased
KATO (7)	Adult rats Wistar-King albino (male)	1 µT 5 µT 50 µT 250 µT	50 Hz circularly polarized	6 weeks	. Nocturnal pineal and plasma melatonin levels: decreased . No dose-response relationship
KATO (8)	Adult rats Wistar-King albino (male)	0.02 µT 1 µT	50 Hz horizontal or vertical	6 weeks	. No significant differences in pineal or plasma melatonin levels
KATO (9)	Adult rats Long-Evans (male)	0.02 µT 1 µT	50 Hz circularly polarized	6 weeks	. 0.02 µT : pineal and plasma melatonin levels: decreased at 12.OO h pineal melatonin level: not decreased at 24.00 h . 1 µT : pineal and plasma melatonin levels: decreased at 24.00 h and at 12.00 h
LOSCHER (10)	Adult rats Sprague-Dawley (female)	0.3 µT 1 µT	50 Hz vertical	12 weeks	. Nocturnal plasma melatonin level: decreased
SELMAOUI (11)	Adults rats Wistar (male)	1 µT 10 µT 100 µT	50 Hz Vertical	12 hours (short term) 4 weeks (long term)	. Short term exposure : 100 µT : plasma melatonin level and NAT activity : decreased (30 %) 1 µT-10 µT : no difference in serum melatonin NAT activity . Long term exposure : 1 µT : no difference 10 µT-100 µt : plasma melatonin decreased NAT activity decreased no dose-response relationship

60 Hz electric and magnetic fields in non rodent mammals

Lee [12] exposed female lambs aged 8 weeks to a mean electric field of 6 kV/m and a mean magnetic field of 40 mG (4 µT) for a year, by keeping them below electric transmission lines. He was unable to show a change in the nocturnal secretion of melatonin or any change in the age of the onset of puberty or estrus. This study have been replicated providing the same negative results.

Baboons [13] were exposed first to an electric field of 6 kV/m, with a magnetic field of 50 µT, and then to an electric field of 30 kV/m and a magnetic field of 100 µT. There appeared to be no alteration in the profile of the plama melatonin concentration during the experiment. However, when the type of exposure was changed to one with « rapid » field onset/offset, there was a reduction of about 15 % of the levels of melatonin previously observed during pre-exposure. These initial results require confirmation .

HUMAN DATA

The data for human subjects is not more consistent than the animal data. Wilson[14] fitted with conventional electric bankets, studied on volunteers the excretion of the principal urinary metabolite of melatonin, 6-sulfatoxy melatonin. He found no change in the urinary excretion of this metabolite. When continuous polymerwire (CPW) electric bankets, generating a magnetic field 50 % greater than conventional electric bankets, were used, 7 of the 28 volunteers showed a drop in their 6-sulfatoxy melatonin excretion during the exposure period, followed by an increase when exposure stopped.

Graham[15] exposed healthy volunteers to a 60-Hz magnetic field of 20 µT, resulting from an ON/OFF effect every 15 secs for one minute, repeated every other hour. The results indicate that there was no statistically significant difference between the exposed and control groups. The exposed subjects were separated, post hoc, into two sub-groups, one with a high, and the other with a low basal melatonin secretion. The response of the exposed subjects with the lowest basal melatonin secretion (< 60 ng/ml) was a reduction in the level of serum melatonin. A replicate experiment failed to find the results reported in the original one : there was no difference in the response to a magnetic field exposure between subjects with a lower basal level of melatonin and the subjects with a higher level. Touitou [16] exposed healthy volunteers to a continuous and intermittent 50-Hz magnetic field of 10 µT. The levels of serum melatonin and urine 6-sulfatoxy melatonin in exposed men did not differ significantly from those in control subjects.

CONCLUSIONS

A diminution and/or a retardation of the nocturnal peak of melatonin have been reported in rodents exposed to electric and/or magnetic fields. Experimental date from primates and man showed insufficient evidence of such a change.
Modification of melatonin secretion cannot be considered at the moment as a verified biological explanation for the epidemiologic studies that find an association between breast cancer or depressive disorders and occupational or residential EMF exposure.

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