Direct suppressive effects of weak magnetic fields (50 Hz and 16(2/3) HZ) On melatonin synthesis in the pineal gland of Djungarian hamsters (Phodopus sungorus)

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Abstract

In many investigations performed thus far on rodents, a suppression of melatonin synthesis was observed when animals were exposed to weak magnetic fields. However, among the several issues not yet resolved is the question of whether the observed changes are caused by direct effects on the pineal gland or by indirect effects, e.g., at the level of the eyes. We, therefore, performed a series of experiments in which direct effects of weak magnetic fields were studied in isolated pineal glands of Djungarian hamsters (Phodopus sungorus). After sacrifice of animals during morning hours, pineal glands were removed and placed individually into glass chambers that were perfused with oxygenated buffer. Experiments (n = 8) lasted for 8 hr. Magnetic fields (1,623 or 50 Hz at 86 microTesla) were generated by Helmholtz coils, and were present during the entire period. In each experiment, 12 exposed, and 12 sham-exposed, pineal glands were placed individually in glass chambers, which were surrounded by identical coils. Because of the design of the coils (bifilament), and the experimental setup (black box), the experimentator was not aware which coil was activated until the results were obtained. After 3.25 hr of adaptation, melatonin production was stimulated by isoproterenol (10(-7) M) for 30 min. Eluted fractions were collected, and melatonin concentrations were measured by radioimmunoassay. Maximum melatonin production was achieved after 5-7 hr. In all experiments, maximum melatonin concentrations were lower in the exposed groups compared with the sham-exposed controls. Statistical analyses for each frequency showed significant suppressive effects at 16(2/3) Hz ($P < 0.01$), and 50 Hz ($P < 0.00$). It is concluded that the suppressive effects of magnetic fields on the synthesis of melatonin are a result of primary mechanisms at the level of the pineal gland.