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Do Magnetic Fields Cause Increased Risk of Childhood Leukemia via Melatonin Disruption?

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Epidemiological studies have reported associations between exposure to power frequency magnetic fields and increased risk of certain cancer and noncancer illnesses. For childhood leukemia, a doubling of risk has been associated with exposures above 0.3/0.4 mT. Here, we propose that the melatonin hypothesis, in which power frequency magnetic fields suppress the nocturnal production of melatonin in the pineal gland, accounts for the observed increased risk of childhood leukemia. Such melatonin disruption has been shown in animals, especially with exposure to electric and/or rapid on/off magnetic fields. Equivocal evidence has been obtained from controlled laboratory magnetic field exposures of volunteers, although the exposure conditions are generally atypical of neighborhood exposures. In contrast, support for the hypothesis is found in the body of studies showing magnetic field disruption of melatonin in human populations chronically exposed to both electric and magnetic fields associated with electricity distribution. Further support comes from the observation that melatonin is highly protective of oxidative damage to the human haemopoietic system. Aspects of the hypothesis are amenable to further investigation.

INTRODUCTION

Various reports [NIEHS, 1999; NRPB, 2001a; CHD, ch. 8, 2002] have discussed the pooled analyses of epidemiological studies by Ahlbom et al. [2000] and Greenland et al. [2000], indicating an approximate doubling of risk associated with magnetic field exposures above 0.3/0.4 mT and such fields have been classed as a possible carcinogen [IARC, 2002]. In addition, there is a body of epidemiological evidence suggesting increased risk of certain other cancer and noncancer illnesses associated with magnetic field exposures. Currently, the strongest evidence appears to relate to increased risk of amyotrophic lateral sclerosis, ALS [NRPB, 2001b; CHD, ch. 15 2002], brain cancer, and leukemia in adults with recent evidence suggesting a link with miscarriage [CHD, chs. 8, 10, and 13, 2002].

The melatonin hypothesis has been widely discussed in terms of exposure to light-at-night, magnetic fields, and breast cancer [Cohen et al., 1978; Stevens, 1987]. However, melatonin disruption by magnetic fields might also account for increased risk of the otherwise disparate range of reported adverse health outcomes. Here we apply the hypothesis specifically to childhood leukemia, namely that exposure to magnetic fields associated with the electricity supply causes increased risk via the disruption of the nocturnal production of melatonin in the pineal gland. Melatonin (N-acetyl-5-methoxytryptamine) has been identified in a wide range of organisms from bacteria to human beings. Its principal source in man is as the chief secretory product of the pineal gland. This follows a marked circadian rhythm, the majority of production occurring at night regulated by nonrod, noncone receptors in the eye sensing the absence of light. Melatonin is remarkably nontoxic and has been found to be a radical scavenger and antioxidant, more effective than either vitamins C or E in vivo [Tan et al., 2003].

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