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## Electromagnetic Fields Affect Human Cells

Electromagnetic fields, similar to those found in overhead power lines, can have a biological effect on human cells, an effect that could contribute to the complex cellular process that leads to cancer, research at Michigan State University shows.

The work of James E. Trosko, a professor of pediatrics and human development, and colleagues is published in the October issue of *Environmental Health Perspectives*, the journal of the National Institute of Environmental Health Sciences.

"Our studies have contributed to what many other studies have shown, and that is that there is a biological effect of the energy imparted by extremely low frequency EMF (ELF-EMF) on living systems," Trosko said.

Until now, he said, most studies on the biological and health effects of ELF-EMF had been "inconclusive or contradictory."

"Until now, the weight of the theoretical and experimental evidence has suggested that ELF-EMF did not have the ability to interact with genetic material to damage it, thereby causing mutations, which we know can lead to cancer," Trosko said.

Trosko and his colleagues studied the effects of ELF-EMF on mouse leukemia cells that had the potential to mature into cells producing hemoglobin after exposure to a chemical. Hemoglobin is the substance which is needed to bind oxygen in blood. They found that electromagnetic fields of 60 hertz and of strengths ranging from .05 to 10 gauss interfered with the chemically induced maturation process in the mouse cells and allowed the cells to continue to proliferate.

After four days of exposure, about 35 percent of the chemically treated cells that were exposed to ELF-EMF showed these effects.

What Trosko and his colleagues found is that ELF/EMF is not a tumor initiator, but rather a potential tumor promoter.

"ELF-EMF doesn't seem to mutate genes, which could convert a normal cell to an 'initiated' cell," he said. "But it can turn them on and off at inappropriate times, causing these initiated cells to proliferate when normally they would just sit there quietly doing nothing."

"The whole point of our study was not to see if extremely low frequency EMF causes cancer, but if it changes gene expression," Trosko said. "The bottom line is we showed there is a biological effect of EMF as measured by altering the expression of the hemoglobin-producing gene."

"I think it's important to note that there is a distinction between a biological effect and a health effect. Just because I sit under a high power transmission line, and just because that exposure might alter some biological activity in my body, that doesn't automatically mean I'm going to get cancer. And even if I should get cancer, it does not mean ELF-EMF had anything to do with the production of that particular cancer."

Trosko pointed out that the process in which a cell changes from a regular, healthy cell to a cancerous one is long and complex, involving different molecular/biochemical steps.

"These initiated cells need promoting agents to bring about cancer," he said. "They could be natural, such as hormones or chemicals in the food we eat. Or they could be man-made chemicals, drugs or pollutants.

"Most importantly, in order to act as a tumor promoter, many conditions must be met, including the ability of the promoter to overcome natural suppressing effects on cell proliferation, timing of the exposure to the promoter, absence of anti-promoters, and exposure for regular and long periods of time."

Other members of Trosko's research team were Gang Chen, Brad L. Upham, Wei Sun, Chia-Cheng Chang, all of the MSU Department of Pediatrics and Human Development; Edward J. Rothwell and Kun-Mu Chen, of MSU's Department of Electrical Engineering; and Hiroshi Yamasaki of the International Agency for Research on Cancer in Lyon, France.

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