Editorial

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In this issue of the European Journal of Oncology we find an important paper on occupational risk of cancer related to exposure to a variety of electromagnetic fields (EMFs), including both low-frequency fields (ELFs) and radiofrequencies/ microwaves (RF/MWs).

Yael Stein, Or Levy-Nativ and Elihu D. Richter of the Hebrew University-Hadassah, Unit of Occupational and Environmental Medicine, Israel, in their paper entitled "A sentinel case series of cancer patients with occupational exposures to electromagnetic non-ionizing radiation and other agents" report a well documented cluster of 47 cancer patients with a multiyear occupational exposure to various types and intensities of EMFs prior to development of the disease (1). The results obtained are well documented and analysed in relation to numerous parameters, including age, latency, type and location of neoplasms, type and duration of EMF exposure.

Of the 47 reported cancer victims, 15 developed cancer with latency periods of less than 5 years and 12 with latency periods between 5 and 10 years. The remaining 20 cases had longer latency periods between first occupational exposure to EMF and diagnosis of cancer. In the <5 year latency group there were 8 haematolymphatic cancers and 9 solid tumours - testis, head & neck (including brain) and gastro-intestinal tract. In both the <5 year and the 5-9 year latency groups there were patients who were exposed to intense levels of EMF, to several types of EMF, or to EMF in combination with ionizing radiation or other exposures, and patients who had direct body contact with the equipment, were in direct focus of high radiation, or worked in small, electronically dense environments. In the >10 year latency group there were more patients with intermittent exposure and patients who were initially exposed at an older age. Many of the reported cancer victims were young and had extremely short latent periods, especially for haematolymphatic and testicular cancers. The fact that latent periods for testicular cancer were very short, haematolymphatic longer and solid tumours still longer suggests a coherent and biologically plausible pattern of latency in relation to the onset of exposure to EMF and other agents. The findings strengthen the hypothesis that these exposures may possibly be the major cause of many of these tumours.

After 30 years of research on bioeffects and health hazards of EMFs, there is still insufficient information on the specific biological influence of

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non-thermal intensity of RF/MW radiation. According to WHO (2) nonthermal intensities of MWs are currently recognized as a "weak factor of biological influence". This imprecise description has initiated searches for biological detectors sensitive enough to measure the "weak biological influence" of MWs. The main problem is that the effects of MWs depend on a variety of parameters (such as modulation, frequency, polarization) and, therefore, specific MW signals should be considered separately, in analogy with toxicology, like specific chemical compounds. From this point of view drawing conclusion from general modulation studies would be like drawing conclusion from combined studies with all chemicals. Furthermore, ELFs and RF/MWs exert very different bioeffects and should be considered separately in terms of their carcinogenic potency. ELFs, to be precise 50/60 Hz magnetic fields of power lines, have for years been listed as IARC 2 B carcinogenic agent (possible carcinogens) on the basis of limited epidemiological evidence (3).

Much less is known on carcinogenic potency of RF/MWs. In 1996-2001 our group from the Department of Microwave Safety at the Military Institute of Hygiene and Epidemiology in Warsaw, Poland published a series of papers which reported a significantly increased risk of various neoplasms (with predominancy of haematopoietic and lymphatic malignancies) in career military personnel exposed for years to relatively strong, pulse-modulated MW fields from radar (4, 5). Similar results were reported in 2000 by Richter *et al*. in radar technicians who developed cancer after relatively short periods of latency (6). Recently, in a retrospective cohort study on Belgian male military personnel exposed to anti-aircraft radar in Western Europe between the 1960s and 1990s, Degrave *et al*. found an untoward incidence of haemolymphatic cancers (7, 8). All these publications report an increased risk of neoplastic diseases in workers exposed for years in relatively strong MW fields.

Studies of cancer morbidity in people exposed to considerably weaker intensities of MW fields, including users of cellular phones, have aroused controversy. Two major groups have been conducting epidemiological research to assess whether cellular phones pose a risk of cancer (9, 10). Although the latency period since people began to use cellular phones has not been long enough to collect many data from long-term users, the Sweden Hardell group's case control studies have consistently found associations between brain cancer of all kinds and prior prolonged use (9, 11). In contrast, the Interphone multinational group study did not find excess risk of gliomas to the entire population from exposure to cellular phones, but they too have found excess risk in a small subgroup of more heavily exposed users associated with latency and laterality (10, 12).

To date, RF/MW radiation has not been classified on the IARC list of carcinogenic substances. The bulk of evidence is still too weak to list RF/MWs as possibly (2B) or probably (2A) carcinogenic for humans, but the above premises are too disturbing to be ignored. Thus, the International Agency on Cancer Research (IARC) in Lyon, France, is working on preparing a monograph No.102 on this subject with a working group scheduled to meet in Lyon on 24-31 May 2011.

It should be pointed out that the paper by Stein *et al*. is an important contribution to our knowledge of the potential carcinogenic potency of EMFs, and would be very useful for experts about to discuss and vote whether or not high frequency EMFs (RFs and MWs) may be considered a carcinogenic factor.

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