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Paper

Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. Alexander Lerchl, Melanie Klose, Karen Grote, Adalbert FX Wilhelm, Oliver Spathmann, Thomas Fiedler, Joachim Streckert, Volkert Hansen, Markus Clemens. Biochem Biophys Res Commun. Dx.doi.org/10.1016/j.bbrc.2015.02.151.

Summary

Most animal studies investigating effects of long-term exposure to radiofrequency (RF) fields on the promotion of tumours initiated by administering the chemical carcinogen, ethylnitrosourea (ENU) have generally found negative results (AGNIR, 2012, SCENIHR, 2015). In contrast, Tillmann et al. (2010) reported that long-term, daily exposure of mice to 1966 MHz UMTS signals at 5 W/kg (peak) following maternal treatment with ENU was associated with an increased incidence of lung and liver tumours. However, an infection in the mice may have influenced these results. Nevertheless, a replication of this study was called for (e.g. SCENIHR, 2015) and now Lerchl and colleagues have recently published a study that, in part, replicates the Tillmann study.

Lerchl and colleagues followed closely the procedures in the Tillman study, but improved it by using larger numbers of animals and two additional exposure levels. Other major improvements over the Tillman study were the use of animals of both sexes, an adequate numbers of animals to be statistically sound, tests for Helicobacter, and conducting histopathological examinations of key tissue samples. While their animal exposure system was well explained in their paper its main limitation is the poor uniformity of exposure between animals, especially when compared to the uniformity of animal exposures obtained by "modern" reverberation chambers. The Lerchl study RF exposure system resulted in calculated local SARs up to 5 times higher than the nominal SAR due to variations in animal size and their position with respect the RF field. A separate group of animals acted as cage controls (no exposure to RF or ENU).

Pregnant mice were injected with ENU and continuously exposed to RF for 24 h/day from day 6 of gestation for 73 weeks, except for 30 min each night, presumably to clean cages. Mice were exposed in small groups in radial waveguides at whole-body specific energy absorption rates (SARs) of 0 (sham), 0.04, 0.4 or 2 W/kg. The effects of RF field exposure alone were not investigated. The frequency and other characteristics of the applied field were not explicitly stated, although it is assumed to be the same as in the Tillmann study (UMTS, 1966 MHz). When mice showed signs of

disease or suffered a sudden drop in weight, they were removed and examined for the number, size and morphology of tumours in different tissues.

Compared to mice given ENU and sham (no RF) exposure, the incidence of benign lung tumours was significantly increased (2 fold) in all exposure groups. There was no evidence of a dose response. The incidence of malignant lung tumours was significantly increased only in the animals exposed at 0.4 W/kg. The incidence of malignant liver tumours was significantly increased (2 fold) in all exposure groups. Again, there was no evidence of a dose response.

The incidence of lymphomas was significantly increased (2.5 fold) only in the group exposed at 0.4 W/kg: in the other exposed groups, the increase was smaller and non-significant. The RF exposure had no significant effect on tumours in the brain, kidney or spleen. Treatment with ENU reduced animal survival rates, but was not affected by RF exposure. Body weights from exposed or sham exposed animals were only slightly different from the cage controls.

Conclusions

While this study was well-conducted and the results are generally consistent with those of the Tillmann pilot study, the incidence of both benign and malignant lung tumours in the Lerchl study following RF exposure was approximately half those reported by Tillmann; the incidence of malignant lung tumours was around 20 % higher and the incidence of benign lung tumours was about 20% lower. While Tillmann did not report any effect on malignant lymphoma in exposed animals, Lerchl and colleagues reported a 2.5-fold increase only in the 0.4 W/kg group. The differences in tumour incidences can be partly due to variations in the experiment and animals used. However, the lack of any dose response, which is not discussed by the authors in much detail, makes the study results much less convincing. Lerchl and colleagues suggest that RF exposure may have caused local thermal effects resulting in metabolic or blood flow changes in the mother and/or foetus that resulted in turn in changes in biokinetics of the ENU. However, if this thermal explanation were correct, it would suggest that the greatest effects would have been obtained using the highest SAR, and this was not seen. At present, no mechanistic explanation can be offered for these results. The authors offer no convincing explanation why exposure at 0.4 W/kg and not the higher exposure, should have the most consistent effect on tumour promotion.

It is surprising that the authors mention in the a~~A~~bstract and introduction of their paper that their "findings may help to understand the repeatedly reported increased incidences of brain tumours in heavy users of mobile phones" and that "Some epidemiological studies, however, have found increased incidences of brain tumours in heavy users of mobile phones". Their paper deals with tumours that are not located in the brain and so the link with the lung and liver tumours they report is very weak.

The authors do not quote the large number of previous studies that found no increase in tumour incidence, so that readers could put their results in perspective; their results are certainly outliers to the main body of scientific results.

Overall, the results of the Lerchl study only provide a hypothesis for further animal studies to be conducted, using a similar but more advanced model (BALB/c or transgenic mice) to determine whether RF exposure has any tumour promoting effect. Given that the results did not find any effect on brain tumours, this does not provide any support for the few epidemiological studies reporting an increase in brain tumours from heavy mobile phone use.

be correlated.

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