

*This abstract is for a presentation made an international conference entitled
“Foundations of bioelectromagnetics: towards a new rationale for risk assessment and management”
convened by the International Commission for Electromagnetic Safety with cosponsors,
the Italian Government Worker Safety Program and, Ente Zona, in Venice, Italy, on December 17, 2007,*

Nerve cell damages in mammalian brain due to microwaves

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During more than 3 billion years, life on Earth was formed by the original physical forces such as gravitation, cosmic irradiation, atmospheric electric fields and the terrestrial magnetism. The existing organisms are created to function in harmony with these forces. However, since the 1940ies microwaves produced by radar and above all, by the modern communication society, are spread around the world. Until then microwaves had principally never been experienced on the Earth. Today, however, one third of the world's population owns the microwave-producing mobile phones and an even larger number are exposed to the cordless RF emitting systems. To what extent are all living organisms affected by these new, almost everywhere present radio frequency fields? And what will be the effects of many years of continuing exposure?

Since 1988 our group has studied the effects upon the mammalian blood-brain barrier (BBB) in rats by non-thermal radio frequency electromagnetic fields (RF-EMF). These have been shown to cause significantly increased leakage of the rats' own blood albumin through the BBB of exposed rats as compared to non-exposed animals—in a total series of about two thousand animals (Salford et al. 1992, 1994, 1997, 2001, 2007; Persson et al. 1997; Nittby et al. submitted manuscript). One remarkable observation is the fact that the lowest energy levels give rise to the most pronounced albumin leakage. If mobile communication, even at extremely low energy levels, causes the users' own albumin to leak out through the BBB, also other unwanted and toxic molecules in the blood, may leak into the brain tissue and concentrate in - and damage - the neurons and glial cells of the brain.

In later studies we have shown that exposure to GSM 915 MHz at non- thermal levels, gives rise to significant neuronal damage ($p < 0.002$) in the brains of rats examined 50 days after a 2 hour exposure at SAR values 200, 20 and 2 mW/kg (Salford et al. 2003). We have followed up this observation in a study where 96 animals were sacrificed 14 and 28 days respectively after an exposure for 2 hours to GSM mobile phone electromagnetic fields at SAR values: 0 (controls), 200, 20, 2 and now also 0.2 mW/kg (Eberhardt et al. Submitted manuscript). Significant neuronal damage is seen after 28 days ($p = 0.01$) and albumin leakage after 14 days – albumin foci ($p = 0.02$) and neuronal albumin uptake ($p = 0.005$).

Our findings may support the hypothesis that albumin leakage into the brain is the cause for the neuronal damage observed after 28 and 50 days.

In our continued research, the non-thermal effects (histology, memory functions) of long-term exposure for 14 months (two hours per week, GSM 100 or 1 mW/kg) are studied. Significant reduction of episodic memory function is demonstrated in exposed animals (Nittby et al. 2007). We have also performed micro-array analysis of brains from rats to short term GSM both at 1,800 MHz and at 900MHz and have found significant effects upon gene expression of membrane associated genes as compared to control animals (Belyaev et al. 2006, Nittby et al. Submitted manuscript).

Our generation has introduced the microwaves on Earth. It is our imperative obligation to further investigate and prevent the possible detrimental effects of microwaves upon biology.

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