Case Reports :Neurological Effects of RFR in Humans

There are quite a number of case reports on the neurological effects of RFR on humans. The following papers were considered by the Working Group as representative examples of studies looking at effects of RFR on the peripheral nervous system causing dysaesthesiae; effects on the CNS are discussed in Annex 4.

I Scott, et al[1] described 10/200 (5%) of patients who were receiving 915MHz hyperthermia treatment in association with ionizing radiation for superficial cancers, and developed dysaesthesiae in adjacent nerves. The effect saturated at the lowest available applied power of 14mW/cm^2

Scott, et al, considered the ten patients had a syndrome of non-specific burning, tingling and numbness in a specific nerve. The effect was patient specific occuring in over two-thirds of the nominal 10-12 treatment sessions of those effected, but the large majority of patients were unaffected. The symptoms saturated at the minimal power density available from the applicator (14mW/cm$^{2)}$. The applicator arrangement led to considerable beam scatter to adjacent tissues; surgical clips were not present.

Once the symptoms developed they were associated with the application of power without a time lag, and ceased at instant of power removal. The authors concluded the symptoms were a “direct result of the microwave field and not a thermal effect” (when a time lag due to thermal inertia would be expected). However a thermal effect cannot be excluded.

II Reeves[4] has reviewed the medical records of 34 patients seen at USAF clinics after overexposure (approx 25-2500 mW/cm^2) to radiofrequency radiation (RFR) between 1973-85 . He found little evidence of tissue damage after medical examination and a screen of blood tests including full blood examination and liver function tests. Some developed dysaesthesia which the author described as “real” but no abnormality was found on nerve conduction studies.

III Schiling has produced two reports of several cases of RFR overexposure [3,4] Some of the cases have had neurological effects of the central, peripheral and autonomic nervous systems.
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IV Several cases of dysaesthesia have been reported after accidental exposures in faulty microwave ovens (2.45GHz)[5,6]. This can result in a very large energy deposition into the hand/s and adjacent body from the typically 600W source.

There maybe frank injury to nerves resulting in muscle fibrillation being detected on EMG studies, as well as effects on sensory nerves.

V Hocking and Westerman have reported various cases associated with mobile phones and antennae.

a) *Phones.* Hocking[7] reported a case series of 40 persons who complained of dysasthesiae associated with use of a mobile phone. A burning sensation or dull ache (quite distinct from an ordinary headache) was felt ipsilateral to the side of use of the phone. It occured minutes after use and lasted minutes or hours. Some cases also reported visual symptoms or not thinking clearly (like being 'hung over'). The mechanism was speculated to be neurological.

Subsequently Hocking and Westerman[8] reported a case of a 72 year old business man who had onset of persistent 'bruised' feeling on the scalp after extensive use of a mobile phone. Neurological investigation found no medical cause. On examination he had altered sensation to cottonwool on the scalp On current perception threshold testing changes were found for the cervical and trigeminal nerve distributions in the area of symptoms.

Hocking and Westerman (unpublished) have recently studied a 34 yr old journalist who complained of occipital pain on using her mobile phone. She agreed to a provocation study in which her phone was wrapped in thin polystyrene (to avoid heating effects) and she spoke into the phone until symptoms occurred (after about 7 min). Current perception threshold testing showed marked changes in the nerves of the affected area compared to the opposite side and to her pre-exposure values.

b) *Antenna*[9]**.** A 31 year old rigger was accidentally exposed to his left face from a 870MHz CDMA panel antenna which was operating at reduced power, for about two hours before it was recognised to be on. He developed headache and blurred vision. When seen next day he had a smaller left pupil and altered sensation to cottonwool on his left forehead. Current perception threshold testing found abnormalities of the left ophthalmic division of the trigeminal nerve, which returned to normal when tested 3 months later. The exposure to the head was well within the limits of the standard.

The cases show that neurological effects in mobile phone users, such as in case Va, may arise from the RFR *per se* independently of the phone and its alleged affects such as heating or position of the head.

VI Hocking, Joyner & Fleming[10] reported an overexposure accident in which little effects were found. Two men were exposed up to 4.6mW/cm^2 of 4.1GHz (CW) for 90 min. When examined 8 days later, apart from hair loss, no significant abnormalities were found.

VII Kolmodin-Hedman et al[11] studied 113 RFR welders (25-30 MHz, the exposures varied but more than 50% of measurements of the machines were in excess of the Swedish ceiling exposure level of 25mW/cm^2) and found 40% had symptoms

of dysaesthesia compared to only 22% of 23 non-exposed controls (matched for manual manipulative work). Two-point discrimination was significantly diminished in welders (39/113) compared to controls (1/23). Nerve conduction studies did not find significant differences in abnormalities between 38 symptomatic welders (12/38) and the controls (5/23 – possibly CTS). Symptoms were not detectable on ordinary nerve conduction tests in 26/38 welders.

Discussion

The above case reports (ROMAN NUMBERS) provide information regarding the neurological effects of RFR. The dysaesthesia have been reported after exposure to diverse forms of RFR including 915MHz (I), radar (II), VHF (II), microwave ovens (IV) and mobile phones (V) and welders (VI).

Some effects have been transitory as with hyerthermia treatment (I) and CDMA exposure (Vb), whereas others have caused lasting effects such as after VHF exposure (III) or after a microwave oven accident (IV).

High exposure such as to a hand in a microwave oven results in frank nerve damage (III). For lower exposures abnormalities are often not detected using ordinary nerve conduction studies (II and VI), but can be detected using more sensitive current perception threshold techniques (Va & b). This indicates the lower exposures have not grossly injured the nerve but have altered its function.

It is noted that only some persons exposed to a source develop dysaesthesia. In the case of the hyperthermia cases only 10/200 (5%) developed dysaesthesia, the two men exposed to 4.1GHz (CW) for 90 mins did not, and obviously only a small fraction of mobile phone users experience symptoms. This suggests either a specific sensitivity of some persons &/or a few who are at the extreme end of a normal distribution of sensitivity develop symptoms.

The importance of modulations in causing effects at low levels of exposure is unclear. Microwave ovens are unmodulated and their effect at high exposure is consistent with thermal mechanisms. It is not known if the cancer hyperthermia treatment (915MHz) was modulated but this is often the case. The absence of effect in the two men exposed to 4.6mW/cm^2 of 4.1GHz which was known to be unmodulated, may be related to this lack of modulation.

Some of these observations confirm current views of RFR mechanisms such as thermal effects from microwave ovens but others raise questions about our current understanding of health effects of RFR. The effect on nerve tissue to alter its function rather than destroy it (Va &b) is not consistent with a simple thermal mechanism. In the hyperthermia cases exposed to 915MHz (I) once the symptoms developed they were associated with the application of power without a time lag, and ceased at the instant of power removal. The authors concluded the symptoms were a “direct result of the microwave field and not a thermal effect” (when a time lag due to thermal inertia would be expected), but a thermal effect cannot be excluded.

These studies whilst of interest and raising various questions worthy of further research do not provide sufficient basis to alter the standard.

References

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