On the need for a better exposure assessment in mobile phone – human volunteer studies

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ABSTRACT

Published studies on the effect of electromagnetic fields from mobile phones on human volunteers have not given any details about SAR expect occasionally the maximum SAR. Not only the maximum encountered SAR value is enough to document. Different mobile phones have a drastically different SAR distribution regarding anatomical localization. The antenna, the chassi as well as internal structure of the device will affect the absorbtion. Recent measurement have shown that phones with about the same maximum SAR can still differ in different regions such as above the ear, on the ear, below the ear, with a factor of 3-5.

Several studies have been published on the effect of electromagnetic fields from mobile phones on human volunteers. The endpoints have been the electrical activity and function of the brain during awake hours as well as during sleep. Provocation studies with people with perceived electrical hypersensitivity have also been done. Almost all of the studies did not give any details about the RF exposure. Typically we are told that " a standard GSM phone was mounted on the subject´s head …." and then we are told the typical GSM 900 pulse sequence, but no details about SAR can be found. Some studies only give incident power density from an antenna some distant away.

It is known that the maximum SAR in the human head from exposure to a mobile phone under normal use can range from 0.1 to 2.0 W/kg and therefore it is not sufficient for the describtion of the experiment and the possibility for others to do a replication. The uncertainty in SAR measurement can be as much as 30% in values in the phantom. The actual value used by the researchers might therefore be 30% less than the stated level

Furthermore, not only the maximum encountered SAR value is enough to document. It is known that different mobile phones (makes and models) have a drastically different SAR distribution regarding anatomical localization. The antenna, the chassi as well as internal structure of the device will affect the absorbtion. Recent measurement have shown that phones with about the same maximum SAR can still differ in different regions such as above the ear, on the ear, below the ear, with a factor of 3-5. Wilén et al. [6] looked at the most commonly used GSM phones from a previous epidemiologial study [4], [5] and the measured distribution of SAR-values over one gram tissue is illustrated in Figure 1.

The previous work by Oftedal et al [4] and Sandström et al [5] indicated that the subjective symptoms occurring in connection with mobile phone use does not occur until the call has lasted a few minutes. Corresponding effect on EEG changes have been reported by Grigoriev et al [1]. If an effects occurs it is also of interest to find out how long after the exposure period the effect persists. Wilén et al [6] in an exploratory study found that people using phones with a high SAR (>0.5 W/kg) experienced more symptoms than those using phones with lower SAR. In view of this the total dose expressed as Specific Absorbtion, SA, in J/kg might be a parameter to make use of in volunteer studies.

Huber et al [2] used a patch antenna system thereby exposing the whole hemisphere of the brain. This might be a good solution in some situations. However, it can be argued that spatial field gradients in the brain are important and that a patch antenna may not reproduce the field gradients arising from exposure to a real cell phone.

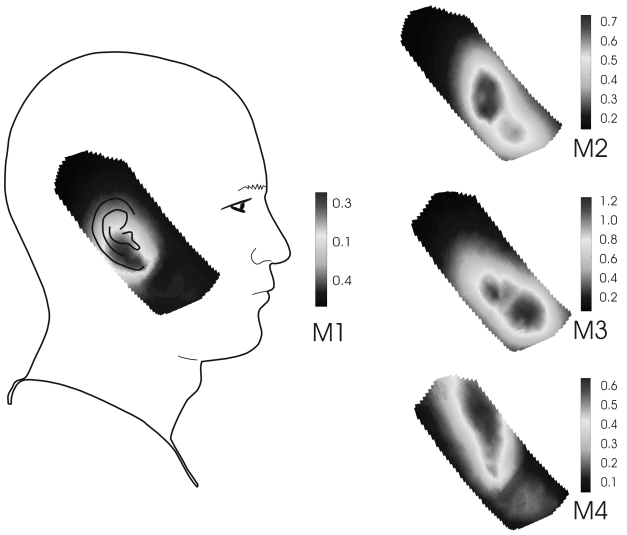

Figure 1. Schematic drawing of the distribution of SAR (W/kg) for the devices used in the study (M1-M4). The figures show the measured SAR on the right hand side of the phantom.

In some situations the ELF exposure from the batteries in the handset [3] might be of interest to include in the exposure, and this would not be present with a patch antenna system

Depending on the purpose of the study an important parameter might be the peak to peak SAR value or the rms time averaged SAR in line with the ICNIRP guidelines. Here of course the various modulation schemes used in mobile telephone come in as possible parameters (i.e. TETRA, UMTS etc).

The blinding of the exposure system should be done in such a way that the operator of the system would not be able to infer the nature of the exposure from across-subject correlations between the system settings and any variation in the dependent variables.

It should also be clear if the standard exposure system, when used to generate GSM signals, would use discontinuous transmission mode (DTX) or just continuous exposure. The introduction of DTX would require detailed knowledge about the statistical properties of the ‘on/off’ cycles occurring during phone use.

In further research with human volunteers it is therefore necessary to state the full SAR distribution from the phone, and the research should have a clear hypotheses of which anatomical structure of the head that is of most importance for the searched for effect. The exposure time should also be given adequate consideration.

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