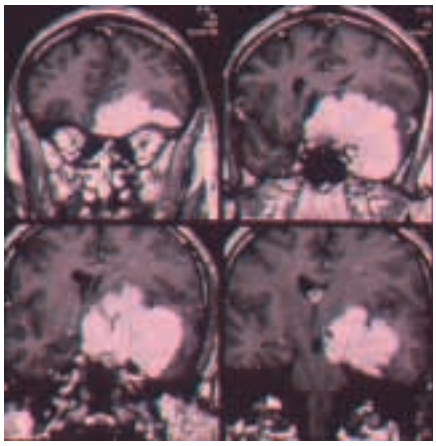
pulses of a base station. Corresponding to the initial publications the study contained the results from two experimental approaches. In the first case 24 young male volunteers were exposed during sleep with an on-off signal (15 minute rhythm), in which the antenna system was located 30 cm from the top of the volunteer's head along the body axes; the volunteer was lying, so that in spite of the different positions of the head, it could be more or less exposed to the same degree. In the second case 16 male volunteers were exposed while sitting with an antenna next to their heads. In this case the volunteers were examined 30 minutes after exposure, which was applied during a three-hour period of sleep on a day after a night where the volunteers did not sleep very much. Despite the different exposure conditions and different physiological situation in both cases an increase in EEG activity in the range of 9-14 Hz after exposure could be determined when compared to the control group. This is all the more astonishing as the detailed calculations carried out on both experimental set-ups showed, of course, for the volunteers a completely different head dosage distribution. Even under conditions where intensities at right-left exposures differed by 1:10, no asymmetric effects in the EEGs could be determined. The authors believe that the measured effect can be traced back to reactions taking place in the hypothalamus, which in both cases absorbed about 0.1 W/kg (in comparison to 1 W/kg average SAR relative to 10 g, which corresponds to the CENELEC-standards). The authors are of the opinion that further investigations on this finding is especially required with regard to the different field modulations (Hüber, R.; Schuderer, J.; Graf, Th.; Jütz, K.; Borbély, A. A., Kuster, N., and Achermann, P.: Radio frequency electromagnetic field exposure in humans estimation of SAR distribution in the brain, effects on sleep and heart rate. Bioelectromagnetics 24, 262-276. 2003).

Interphone – seeking the cau

Christoph Bächtle

The project "Interphone", is the most extensive research project being conducted under the direction of the World Health Organization (WHO) with scientists from 13 countries, including three working groups from Germany. They want to find out if there is a correlation between using a mobile phone on a regular and long term basis and the development of brain tumours.

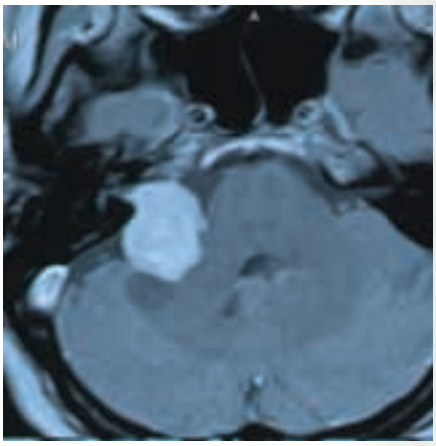


Slides of different layers of the human brain in the cranial capsule. Clearly visible (the lighter shaded areas) is a tumour (meningioma), in the area of the temporal lobe, which is generally benign. However, this type of tumour could lead to vision problems and paralysis in the area of the eye.

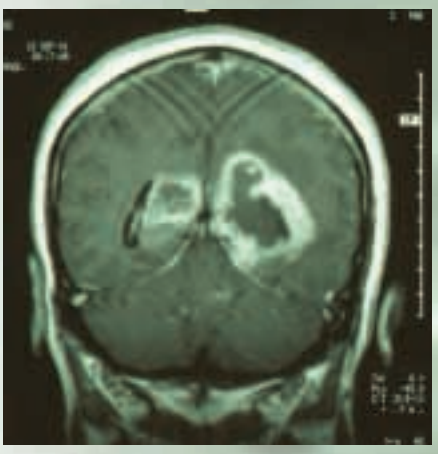
Every year alone in Germany 14,000 men and women are diagnosed with a brain tumour, children seem to be excessively affected. It is not fully understood why brain tumours develop, and to date the findings on the subject have been contradictory. What is certain, however, is that a correlation does exist between exposure to high doses of ionised radiation (e.g. radiation from x-rays) and the development of brain tumours. In the field of "job related exposure", pesticides, herbicides, solvents and petrochemical products have been identified as risk factors.

The results of the Interphone study should be able to provide some answers to the question as to whether or not there is a correlation between brain tumours occurring and exposure to the electromagnetic

ses of brain tumours



A slide of the human brain in the cranial capsule. The light round area in the centre shows an "acoustic neurinoma" i.e. a tumour which causes hearing problems and problems with balance. In the later stages of this tumour there is an increase in the pressure of the brain and EEG-changes, and there are also changes in the acoustically stimulated electric conductivity of the brain.



In this slide of the human brain a tumour in the shape of a butterfly can be seen. (butterfly glioma) which especially develops in old age and spreads very quickly.

fields used in mobile radio communication systems. From Germany the following institutions are taking part in the Interphone study: the Department of Environmental Epidemiology of the German Cancer Research Centre in Heidelberg, the Institute for Medical Statistics and Epidemiology of the University of Bielefeld and the Institute for Medical Biometry, Epidemiology and Informatics of the University of Mainz. The coordination of the German study groups is being done by the scientists in Mainz. The project is mainly financially supported by the Fifth Framework Programme of the European Union.

In 1998 and 1999 scientists from 14 countries conducted a feasibility study under the direction of the WHO's IARC International Agency for the Research of Cancer, to find out whether or not such a research programme could be realized at all and if so, how could the concept be meaningfully transposed. The findings of the feasibility study were as follows: the experts are of the opinion that a study conducted on seeking explanations for the causes of brain tumours is significant and feasible. One of the main focal points of the Interphone study is to determine if electromagnetic fields from mobile telephones increase the risk of developing a brain tumour. A report by the IARC stated, among other things, the following: "if the risk of developing a brain tumour exists at all, the wider use of mobile telephones and the expected number of people who will develop a brain tumour will be sufficient enough to establish a potential risk

increase by a factor 1.5 – provided the probands have used a mobile phone for at least 5-10 years".

Therefore, people between the ages of 30-59 are of interest for the Interphone study since they fulfil the required profile specifying how long and how frequently the person has used a mobile phone. To take part in the study they have to have telephoned frequently and on a regular basis during the last 5-10 years. This is a criterion that, for example, youths or young adults at about 20 years of age cannot not currently fulfil. They could, however, in 5 years time be an interesting target group for further research.

Within the framework of the Interphone investigation countries were chosen where mobile telephones have been used longer and where there is a high density of mobile phone use. With these framework conditions, the researchers want to determine, if it exists, the probability of a risk increase. Interphone is exclusively investigating if there is a correlation between brain tumours and mobile telephone use, base stations are presently not being taken into account.

Those who are responsible for the study have chosen the investigation method called "case-control study". With this epidemiological procedure two investigation groups are compared to each other which have similar characteristics, but also have an essential characteristic difference, e.g. an illness. The Interphone study deals with two distinct groups, one group of patients is from a defined study area with specific brain tumour types, the other group consists of healthy individuals randomly chosen from the same area corresponding in age and sex to the representatives of the group affected with brain tumours.

Brigitte Schlehofer from the working group Environmental-Epidemiology at the German Cancer Research Centre in Heidelberg explained the following: "We have already done studies on risk factors for brain tumours in adults using the case-control study method, so therefore, we have been able to gain experience with this method".

The data which will be compared and form the basis for a proposition to be made later are compiled from interviews. The interviews were exclusively done by qualified employees who were specially trained to do this. "The questionnaire is basically the same for each country's working group, the evaluation protocol is also identical for all of the participating countries, therefore, the comparability of the findings is ensured. Although the list of questions in the various countries can be supplemented with additional questions", said Brigitte Schlehofer. In computer aided interviews volunteers are asked questions about when and how often they use a mobile phone, when telephoning if a hands free mobile communication set was used and if the phone has an internal or an external antenna. Other questions referred to whether the volunteer works or worked in a profession where he/she was exposed to electromagnetic fields, especially high frequency fields and how long he/she has been working or worked at this job. It was also noted which medical or other risk factors the volunteers are confronted with on a regular basis. The interview takes 40-60 minutes to complete.

In Germany within three years 700 volunteers affected with a brain tumour and 1400 control volunteers should be interviewed. Concerning the study in its entirety, scientists will gather data from 7,500 affected volunteers and from just as many control volunteers. Elizabeth Cardis of the IARC is of the opinion that the Interphone study is pointing the way with regard to large-scale population studies. Obtaining data in an interview has been proven to be difficult since especially in the control group the willingness to participate has been moderate. The reason for this is that the control group was randomly chosen from the address files of the registration offices and these people were sent letters requesting them to participate in the study. After 4 weeks if no answer was received, the person received a second letter, if there was still no response, scientists attempted to get in touch with these people personally. "About two-thirds of the people in the control group who received a letter responded positively and are taking part in the study", estimated Brigitte Schlehofer. In the group of persons affected with a brain tumour the rate of participation is clearly higher and this was indeed very gratifying for the scientists. "More than 85% of the people we wrote to are taking part in the study", reported a scientist from Heidelberg.

The central focus of the study is to investigate three different types of brain tumours: acoustic neurinoma, glioma and meningioma.

Acoustic neurinoma is a tumour which is caused by degeneration of Schwann's cells which form a sheath around nerve cells. When a degenertion of the vestibular nerve occurs, it is called an acoustic neuroma. This type of tumour is benign and can occur in the inner ear and in the ear canal. Degenerated astrocytes are the cause of glioma tumours. These tumours grow rapidly and can infiltrate surrounding tissue. Meningioma tumours spread from one of the meninges; the arachnoid membrane. They grow slowly and are generally benign. Meningioma tumours mostly occur in the brain but they also can occur in the spinal column. Data from circa 6000 individuals affected with a giloma or a meningioma tumour should be recorded in the Interphone study, as well as, 1000 patients with an acoustic neurinoma. The recording of the data is currently in full swing and should be completed in October 2003. The evaluation of this extensive information will take until the end of 2004, at the earliest the findings will be published sometime in early 2005.

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