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A story about Mobile Phone Radiation and Alzheimer's disease

Are electromagnetic fields in mobile communication harmful?

A team of the clinical researchers in Lund, Sweden, found that electromagnetic radiation, such as those used in mobile communications, at shallow power values (<2 W/kg), cause users' blood albumin to leak through the blood-brain barrier "BBB" into the brain tissue.

They exposed rats to different magnetic and electromagnetic fields as well as continuous and pulsed 915 MHz microwaves modulated at different repetition rates (50-200 pulses per s) GSM-900 and GSM-1800.

The BBB is supposed to protect the brain against unwanted and toxic molecules potentially present in the blood, to transfer to the brain tissue. However, our team in Lund found after exposure of rats to the radiation from mobile telephones albumin from the blood leak into the brain and accumulates in neurons and glial cells (Persson, 2021).

The studies performed at the Lund University by:
Neurosurgeons: Leif Salford MD, PhD professor em,,
Henrietta Nittby MD, PhD,
Neuropathologist: Arne Brun MD, PhD professor emeritus.
Medical Physicist: Bertil RR Persson PhD MDhc prof. em..
Jacob Eberhardt PhD, Electric engineer:
Lars Malmgren Techn. Dr.

Their results are collected in the book

"More Probable than Unlikely"-

A Tale of the Blood-Brain Barrier and Mobile Communication
Dedicated to Leif G. Salford on his 80th birth day 2021-12-07

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(Persson, 2021)

Leif Salford spoke before the EU Parliament 2000-06-29

"Les effets possibles sur la santé des ondes électromagnétiques de hauates fréquences (telephonie mobile)"

In his conclusion at the presentation, he stated the following:

If mobile communication, even at extremely low SAR values, causes the users' own albumin to leak through the BBB, which is supposed to protect the brain, other unwanted and toxic molecules in the blood can also leak into the brain tissue and concentrate in the brain's neurons and glial cells. It cannot be excluded that this (especially after many years of intensive use) may promote the development of autoimmune and neurodegenerative diseases.

The future? - is it dangerous? –
We don't know yet!

This question has recently taken a new turn with Transcranial electro-magnetic therapy against Alzheimer's disease.

Arendash and coworkers reported in 2010 that treatment with electromagnetic fields protects against and reverses cognitive impairment in mice with Alzheimer's disease (Arendash et al., 2010).

Arendash's report indicates that prolonged exposure to electromagnetic fields directly associated with cell phone use (915 MHz; 0.25 W/kg) confers cognitive benefits. They observed both cognitive protective and cognitive enhancing effects of EMF exposure for both normal mice and transgenic mice designed to develop Alzheimer's-like cognitive impairment.

Their results indicate EMF exposure at permitted ICNIRP levels could possibly apply as a non-invasive, non-pharmacological therapy for Alzheimer's disease (AD) that effectively improve memory (Arendash et al., 2010).

Zhi and coworkers reported in 2023 that 900 MHz electromagnetic field exposure alleviated AD-like symptoms in APP/PS1 mice, potentially leading to a non-invasive strategy for AD treatment (Zhi et al., 2023).

APP/PS1 mice and WT mice were exposed to long-term microwave radiation for 270 days (900 MHz, SAR: 0.25–1.055 W/kg, 2 h/day, alternately), and evaluated after 90, 180, and 270 days. They assessed cognition in the Morris water maze, Y-maze, and novel object recognition. Congo red staining, immunohistochemistry and ELISA used to analyze Aβ plaques, Aβ40 and Aβ42 content.

Differentially expressed proteins in the hippocampus between microwave-exposed and unexposed AD mice identified by proteomics.

Spatial and working memory improved in AD mice after long-term 900 MHz microwave exposure compared to after sham exposure.

Microwave irradiation (900 MHz) for 180 or 270 days did not induce AP-plaque formation in WT mice but inhibited Aβ accumulation in the cerebral cortex and hippocampus of 2- and 5-month-old APP/PS1 mice. This effect occurred mainly in the late stage of the disease and may attribute to downregulation of apolipo-protein family member and synuclein-alpha expression and excitatory/inhibitory neurotransmitter rebalance in the hippocampus.

The current results indicated that long-term exposure to microwave radiation reduce the progression of AD and exert a beneficial effect against AD symptoms, suggesting that 900 MHz microwave exposure may be a potential therapy for AD (Zhi et al., 2023).

Clinical studies

In 2019, Arendash and coworkers reported the results of a clinical trial of transcranial electromagnetic therapy (TEMT) in Alzheimer's disease that

showed cognitive improvement and associated changes in cerebrospinal fluid, blood, and brain imaging (Arendash et al., 2019).

Conducting TEMT use a helmet-device that has eight antennas embedded between the device's two-layered head shell. The treatment carried out with two 1-hour exposures within 24 hours with at least a 7-hour interval between these two daily treatments.

When treatment is in progress, the device transmits electromagnetic waves at the carrier frequency of 915MHz with a pulse repetition frequency of 217 Hz sequentially through the eight antennas. This sequence corresponds to the one used in Lund to simulate the effect of mobile phones on the BBB in Fischer rats (Persson, 2021/).

Power levels (Specific Absorption Rate, SAR) for each emitter were set to an average of 1.6 W/kg.

Treatment of eight AD patients with mild/moderate AD-symptoms for 2 months with TEMT took place for two 1-hour periods each day. They evaluated the subjects before the treatment, at the end of the treatment and 2 weeks after the end of the treatment.

No harmful behavioural effects discomfort or physiological changes appeared from 2 months of TEMT treatment, as well as no signs of induction of tumorigenesis or micro bleeding.

The TEMT treatment induced clinically important and statistically significant improvements in cognition-related symptoms.

The TEMT treatment also affected the cerebrospinal fluid (CSF) and plasma in terms of:

- levels of soluble proteins Aβ1-40 and Aβ1-42 in CSF,
- cognition-related changes in CSF oligomer-Aβ,
- a decreased CSF p-tau/Aβ1-42 ratio and
- reduced levels of Aβ-oligomer in plasma.

Pre- and post-treatment FDG-PET brain scans revealed stable cerebral glucose utilization. In addition, some subjects also showed improved glucose utilization.

Evaluation of fractional anisotropy (FA) in diffusion-tensor imaging (DTI) with magnetic resonance scans of individual subjects provided support for TEMT-induced increases in functional connectivity of neurons within the cognitively important cingulate cortex/cingulum area of the brain.

Conclusion: TEMT treatment of AD patients appears to be safe while producing cognitive improvement, changes in CSF/blood AD markers, and indications of stable/enhanced brain connectivity (Arendash et al., 2019).

Cao and colleagues (including Arendash) reported in 2022 that transcranial electromagnetic therapy (TEMT) normalizes cytokine levels both in the blood and in the brain of the Alzheimer's patients. This could explain that the treatment reduces the patient's symptoms of cognitive impairment (Cao et al., 2022).

The immune system plays a critical role in the development and progression of Alzheimer's disease (AD). However, there is disagreement as to whether the development/progression of AD involves an increased or a decreased activation of the immune system. In both scenarios, immune system cytokine levels are abnormal in AD and need of rebalancing.

In the subjects who daily for 2 months, AD patients with low baseline values of plasma, cytokine levels always showed increases in these cytokines.

In contrast, AD subjects with high baseline level of plasma cytokine at both time points showed treatment-induced reductions in plasma cytokines. Thus, a rebalancing to normal plasma cytokine levels occurred with both acute and prolonged TEMT.

In CSF, TEMT induced a similar normalization for seven measurable cytokines, with the direction and magnitude of changes in individuals also linked to their baseline CSF levels.

Their results strongly suggest that daily TEMT to AD patients for 2 months can normalize levels of 11 out of 12 cytokines in blood and/or brain, which is associated with improvement of their cognitive symptoms.

This normalization of cytokines and in both the brain and blood plasma, of TEMT action may contribute significantly to its potential to prevent, stop or improve the symptoms of AD (Cao et al., 2022).

In summary, the results of TEMT treatment pose great challenges to epidemiological studies of the health effects of mobile phones and the treatment of AD and other neurological diseases**.**

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