

Long-Term Mobile Phone Use Leads to Brain Tumors

Lai Lei Lou

Ningbo University of Technology, China

INTRODUCTION

Mobile phone has been widely used and there were almost 7 billion mobile subscriptions in May 2014, equivalent to 95.5% of world's population (The International Telecommunication Union, 2014). However, the safety of mobile phone use has been raised simultaneously. Mobile/cordless phone use means that people are using mobile/cordless phone near their ears to communicate with other people. Specifically, people are concern whether the radio frequency radiation emitted by mobile phone will bring adverse effects to human health, especially brain tumors. Younger people are increasingly common among the new generations of mobile phone users (Lenhart, Ling, Campbell, & Purcell 2010). They will have longer time to expose to mobile phone radiation and might have a higher risk of developing brain tumors.

OVERVIEW

Professor Lennart Hardell at the University Hospital in Sweden is the pioneering and leading scholar in mobile/cordless phone use and brain tumors (Baan et al., 2011; Davis, Kesari, Soskolne, Miller, & Stein, 2013; Hardell et al., 1999, 2013). Hardell and his colleagues published the first article about mobile/cordless phone use and brain tumors (Hardell et al., 1999). He included cases and controls during 1994 – 1996. In the past twenty years, professor Hardell has been studying mobile/cordless phone use and different tumors risk. In his latest study, Hardell and his group

has confirmed that long term mobile phone use would increase glioma and acoustic neuroma risks (Hardell et al., 2013).

Mobile Phone Radiation

Nonionizing electromagnetic fields (EMFs) include low-frequency and high-frequency EMFs which have photon energy less than 10eV. This level of energy is not adequate to break bonds and ionize the atoms, as ionizing radiation. Mobile phone radiation belongs to high-frequency EMFs in the microwave range (Corle, Makale, & Kesari 2012; Feychting, Ahlbom, & Kheifets, 2005). Mobile phone emits radio frequency electromagnetic fields (RF-EMF) when in use. RF-EMF is strongest at the source and weaken exponentially away from the source. The mobile phones are held in close proximity to the head, or within a meter of the head when hands-free sets are used. RF-EMF is then highly concentrated on the temporal lobe, an important brain region dealing with auditory perception and memory, on both sides of head near ears. The emitted RF-EMF has been shown to have many effects upon the mammalian brain; such as alterations of cognitive functions (Nittby et al., 2008), gene expression alterations in cerebellum (Belyaev et al., 2006), and increase the likelihood of brain tumors (Hardell et al., 2009).

Many countries have set safety standards and regulations for mobile phone use. Specific absorption rate (SAR) is used to measure the rate at which mobile phone radiation is absorbed by the human body. In the U.S.A., the Federal Communications Commission (FCC) has set a SAR limit of 1.6 watts

per kilogram (1.6W/kg), averaged over a volume of 1 gram of tissue for the head. In Europe, the limit is set to be 2W/kg, averaged over a volume of 10 grams of tissue for the head.

However, in the U.S.A. current standards for exposure to RF-EMF were set more than fifteen years ago. The General Accountability Office (GAO) advised the U.S. Congress that standards for mobile phones should be reassessed since both the mobile phone users and their uses have changed dramatically during the last two decades. Mobile phone users tend to become younger. American Academy of Pediatrics (AAP) sent a letter to the U.S. Congress to address that children have thinner skulls, smaller heads, and more fluids in their head, they will absorb more quantities of RF-EMF in their brains than adults users. AAP urged the U.S. Congress when setting any new standards for mobile phones or other wireless devices, it is essential based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes (Davis et al., 2013).

Brain Tumors

A tumor is a mass of tissue that is formed by an accumulation of abnormal cells. Tumor cells grow, even though the body does not need them, and like normal old cells, they don't die. As this process goes on, the tumor continues to grow as more and more cells are added to the mass.

Brain tumors include any tumor that starts in the brain, from brain cells, the membranes around the brain (i.e. meninges), nerves, and glands or sometimes spread from other part of the body. There are over 120 different types of brain tumors (National Brain Tumor Society). The most common brain tumors are called gliomas, which originate in the glial (supportive) tissue. About one third of all primary brain tumors and other nervous system tumors form from glial cells, which are cells that help keep nerves healthy. The second most common type of brain tumors

are meningiomas. These form in the meninges, the thin layer of tissue that covers the brain and spinal cord.

Brain tumors are classified based on the location of the tumor, the type of tissue involved, whether they are benign or malignant. Benign brain tumors are noncancerous. Malignant brain tumors are cancers, typically grow faster than benign tumors, and aggressively invade surrounding tissue. Although brain cancer rarely spreads to other organs, it will spread to other parts of the brain and central nervous system. Benign brain tumors usually have clearly defined borders or edges and are not deeply rooted in brain tissue. This makes them easier to surgically remove than malignant brain tumors. Among various brain tumors, gliomas, acoustic neuroma, and meningiomas have been most studied in the mobile phone health literature.

Gliomas are the most common brain tumors that are malignant and rarely curable, consisting of more than 60% of central nervous system tumors (Hardell et al., 2009). Symptoms of brain tumors vary according to the type of tumor and the location. A brain glioma can cause headaches, nausea, vomiting, seizures, and cranial nerve disorders. A glioma of the optic nerve can cause visual damage and even blindness. Spinal cord gliomas can cause pain, weakness, or numbness in the extremities (Medical Encyclopedia, A.D.A.M., 2011).

Astrocytomas are the most common gliomas. In adults, astrocytomas most often occur in the cerebrum, which is the largest part of the brain. The cerebrum uses sensory information to tell us what is going on around us and how our body should respond. The cerebrum also controls speech, movement and emotions, as well as reading, thinking and learning. There are five types of astrocytomas:

1. **Grade I:** Pilocytic astrocytoma.
2. **Grade II:** Diffuse astrocytoma/low-grade astrocytoma.
3. **Grade III:** Anaplastic astrocytoma.

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