

# Mobile phone induced sensorineural hearing loss

Surayie H. Al-Dousary, MD.

## ABSTRACT

The increased use of mobile phones worldwide has focused interest on the biological effects and possible health outcomes of exposure to radiofrequency fields from mobile phones, and their base stations. Various reports suggest that mobile phone use can cause health problems like fatigue, headache, dizziness, tension, and sleep disturbances; however, only limited research data is available in medical literature regarding interaction between electromagnetic fields emitted by mobile phones and auditory function; and the possible impact on hearing. We report a case of sensorineural hearing loss due to Global System for Mobile Communications mobile phone use, in a 42-year-old male.

*Saudi Med J 2007; Vol. 28 (8): 1283-1286*

*From the Department of Otorhinolaryngology, King Abdul-Aziz University Hospital, College of Medicine, King Saud University, Riyadh, Kingdom of Saudi Arabia.*

*Received 22nd March 2006. Accepted 8th November 2006.*

*Address correspondence and reprint request to: Dr. Surayie Al-Dousary, Department of Otorhinolaryngology, King Abdul-Aziz University Hospital, College of Medicine, King Saud University, PO Box 245, Riyadh 11411, Kingdom of Saudi Arabia. Tel/Fax. +966 (1) 4775748. E-mail: sdousary@cec.net.sa*

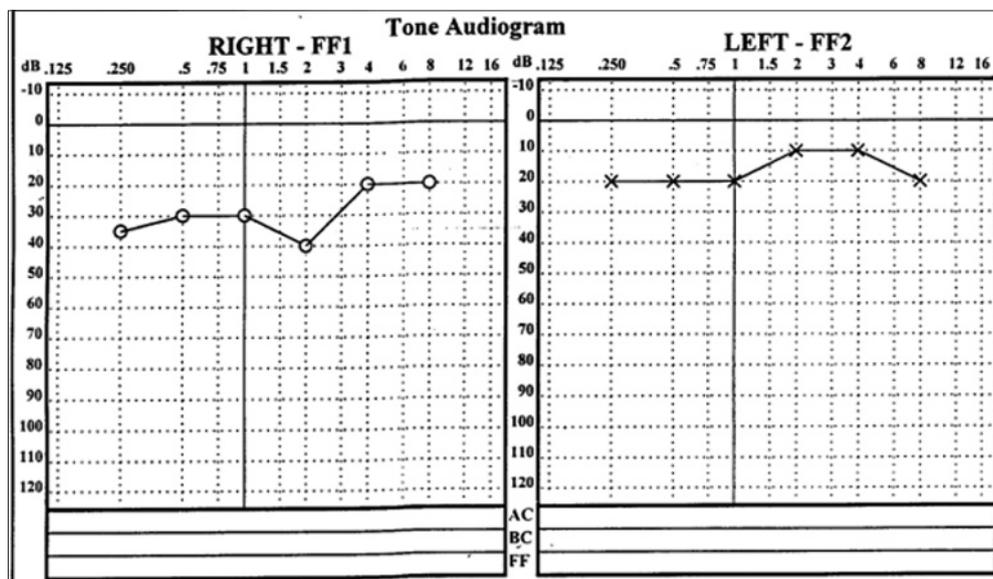
Mobile phone use is ubiquitous.<sup>1</sup> Rapid growth of the mobile telecommunication, that there will be approximately one billion mobile phone users before 2005,<sup>2</sup> and certainly their number will continue to increase for the foreseeable future. The fact that so many people use mobile phones attests to their importance to the general public. This extensive use of mobile phones has given rise to concerns regarding the potential influences of electromagnetic fields on human health thereby generating a public debate regarding their possible health hazards. As reported in medical literature, mobile phones may cause adverse health problems such as headache, sleep disturbances, impairment of short term memory, and more seriously,

significant increase in the frequency of seizures in epileptic children, brain tumors, and high blood pressure among users.<sup>3,4</sup> In addition, mobile phones can cause discomfort, lack of concentration, dizziness, and skin burning sensation.<sup>4</sup> There are 2 direct ways by which health could be affected as a result of exposure to radiofrequency field radiation; the thermal (heating) effects caused mainly by holding a mobile phone close to the body, and as a result of possible non thermal effects.<sup>3</sup> Anatomically, the ear being in close proximity to the mobile telephone during use should, logically, be at a higher risk of potential damage; however, hearing loss due to mobile telephone use has not been described in medical literature.<sup>5</sup> The WHO publish an article in 1996 titled Review Article low-level Exposure to Radiofrequency Electromagnetic Fields: Health Effects and Research Needs and here, we present a case of mild sensorineural hearing loss (SNHL) due to global system for mobile communications mobile phone use.

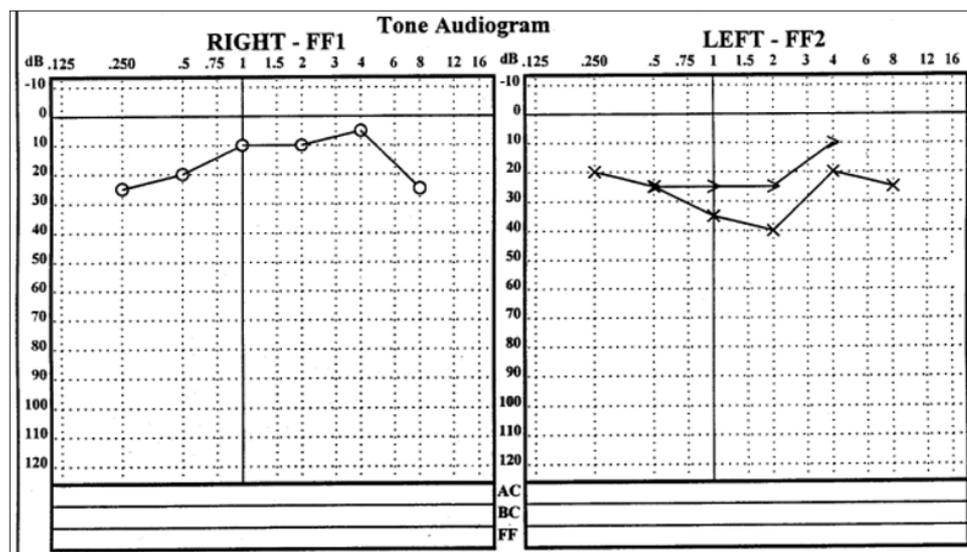
**Case Report.** A 42-year-old male, businessman, referred to King Abdul-Aziz University Hospital, Riyadh, Kingdom of Saudi Arabia, with the chief complaint of diminished hearing in the right ear for the last 3 months. In addition, the patient gave history of burning sensation and dull ache, in and around the right ear, associated with mobile phone use. The symptoms often began a few minutes after beginning a call, and would usually cease within an hour or so after the call was discontinued. Symptoms did not occur when using an ordinary land line phone handset, and were different from ordinary headaches. The patient had been using a mobile phone for more than 90 minutes every day almost exclusively in the right ear, as a habit. The patient also gave a history of allergic nasal symptoms and occasional headache, and denied any history of ear discharge, dizziness, nausea and vomiting, or both, trauma, exposure to noise, or use of ototoxic drugs. The patient denied any past medical illnesses, and did not smoke. A complete ear, nose, and throat (ENT) examination was carried out, including audiological assessment, in addition to routine laboratory tests including brain, and sinus CT. The ENT examination was unremarkable except for minimal uncomplicated

bilateral nasal polyposis; tuning fork tests were within normal limits. The pure-tone audiometry revealed mild (25 db) SNHL in the right ear; tympanogram showed normal type 'A' curve in both ears; auditory brainstem response and electrophysiological audiometry revealed normal auditory evoked potentials bilaterally. The electrocochleography (ECOG) showed normal response bilaterally. Laboratory works were within normal limits.

The brain computerized scan (CT) contrasted and non-contrasted study was normal while the CT of sinuses revealed mild to moderate polypoidal sino-nasal disease, predominantly involving the ethmoids, and both maxillary sinuses. The patient was followed up on approximately every 3 months, for the next 2 years. A serial audiogram were carried out on the first 2 visits and showed progressively increasing mild SNHL in the



**Figure 1** - The pure tone audiometry of the patient showing progressive sensorineural hearing loss in the right ear, and normal hearing threshold in the left ear.

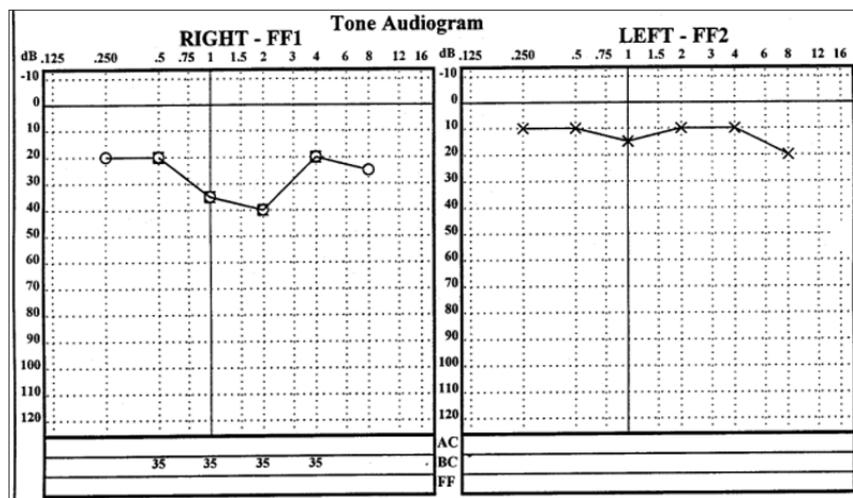


**Figure 2** - The pure tone audiometry of the same patient showing return to normal hearing in the right ear, and progressive sensorineural hearing loss in the left ear as he switch using the mobile phone from right to left ear.

right ear as depicted in **Figure 1**. Since the patient was using the mobile phone almost exclusively in the right ear, and it was causing symptoms of decreased hearing, the patient was advised to make use of the left ear, instead. After using the mobile phone in the left ear for 6 months, the subsequent audiogram results showed improvement in hearing threshold in the right ear, and progressive SNHL in the left ear as seen in **Figure 2**. It is important to mention that the pre-exposure hearing threshold in the left ear was normal, as shown in **Figure 1**. The patient was then instructed to stop using the mobile phone in the left ear, and switch it to the right ear. Follow up audiograms, after 3 months, showed return to normal hearing in the left ear and mild SNHL in the right ear, as shown in the audiograms in **Figure 3**. Over the next 6 months, the patient reduced mobile phone use to less than 15 minutes per day, and began to use a handset with speakerphone facility. A repeat audiogram was carried out 2 years later and showed slight improvement in the hearing threshold of the right ear, as well.

**Discussion.** The wide spread use of mobile phones has given rise to concerns regarding the potential influences of electromagnetic fields (EMF), emitted from mobile phones on human health.<sup>5</sup> The growing number of cellular phone users increases the interest in the effect of EMF emitted on live organisms.<sup>6</sup> A mobile telephone works by transmitting and receiving low levels of radio frequency radiation. Despite unavoidable uncertainty, current scientific data are consistent with the conclusion that public exposures to permissible RF levels from mobile telephony and base stations are

not likely to adversely affect human health.<sup>7</sup> Although there is plenty material on the biological effects of radiofrequency field, current risk assessment is still limited.<sup>8</sup> There are uncertainties as well, regarding the characteristic exposure to EMF such as magnetic field frequency and exposure intermittence, and not much is known on the possible confounding or effect modifying factors.<sup>9</sup> The alleged health effects of low level radio frequency radiation (RF) used in transmission of mobile phones are contentious, nonetheless, symptoms like headache, unpleasant sensations such as burning feeling or a dull ache mainly occurring in the temporal, occipital or auricular areas have been reported.<sup>1</sup> The surveys on the subjective complaints of cellular telephone users carried out in Sweden, Norway, UK, USA, New Zealand, and Australia showed that headache is the major complaint. Apart from headache, fatigue and general ill-being, muscular pains, and nausea were also reported. The surveys indicated that the EMF of the microwave frequency, including the frequency emitted by cellular phones may be responsible for various measurable biological effects.<sup>6</sup> Biological effects of the mobile phone microwave radiation depend on many factors: the duration of the irradiation, individual characteristics of the central nervous system and immune systems, and other factors<sup>10</sup> like the rate of absorption and the distribution of EMF energy<sup>5</sup> by different tissues of the body. Despite public concerns regarding the safety of mobile phones and their base stations, little research specifically relevant to these emissions has been published in peer-reviewed scientific literature. This presumably reflects the fact that it is only recently that mobile phones have been widely used by the public and there has been little opportunity for all the health effects



**Figure 3** - The pure tone audiometry of the same patient showing return to normal hearing in the left ear, and progressive sensorineural hearing loss in the right ear. Since he switch using the mobile phone from left to right side.

to manifest. Moreover, populations as a whole are not genetically homogenous and people can vary in their susceptibility to the environmental hazards,<sup>11</sup> such as the EMF from mobile phones. Since the mobile phones are usually held in close proximity to the external ear, the hearing should potentially be the most affected target of thermal and nonthermal effects. Heating of biological tissue is known to occur as a consequence of EMF energy absorption by the water in the tissues,<sup>5</sup> which may damage the piezoelectric properties of the outer hair cells (OHC) of the cochlea. Although the cochlea is well protected by very dense compact bone, the OHC of the inner ear are known to be vulnerable to various noxious factors including heat generated by the EMF. This temperature rise has been considered to be too low to cause adverse effects. However, if the exposure to EMF's is for a longer duration, there is likelihood of damage to the OHC, with resultant hearing impairment in susceptible individuals. This hearing loss is reversible in the short term, which is very clearly demonstrated by our patient, who was using the mobile phone for more than 90 minutes every day almost exclusively in one ear, and when he used the mobile phone in the other ear his hearing in the previously affected ear improved while deteriorated in the ear exposed to the EMF energy of the mobile phone. A 10 db confirmed threshold shift from baseline in pure tone average at 2000, 3000, and 4000 Hz Occupational Safety and Health Administration (OSHA) standard threshold shift), while not necessarily resulting in significant impairment, is an important early indicator of permanent hearing loss.<sup>12</sup> It is only recently that some studies have concluded that a higher incidence of mild hearing loss is associated with long term exposure to the EMF generated by mobile phones.<sup>13,14</sup> However, the exact cause still remains unclear. We, therefore, suggest a prospective study to be undertaken to measure the hearing function before, during, and after EMF exposure, as well as a long term follow up of any chronic alterations in hearing function.

In conclusion, the use of mobile phones is a risk factor for certain health hazards. In addition to other symptoms, mobile telephone use can cause mild threshold shift in the hearing of susceptible individuals. Physicians and users alike, should be aware of this. Moreover, susceptible individuals who exhibit such

10 db threshold shifts on serial audiometric testing should be carefully evaluated, and counseled regarding avoidance of noise and excessive use of mobile phones. The excessive use of mobile phones should be discouraged by educating the general public, more importantly, further work is needed to determine the mechanism causing temporary or permanent, or both, hearing threshold shift in the susceptible mobile phone users.

## References

1. Hocking B. Preliminary report: Symptoms associated with mobile phone use: addendum. *Occup Med (Lond)* 1998; 48: 472.
2. Repacholi MH. Health risks from the use of mobile phones. *Toxicol Lett* 2001; 120: 323-331.
3. Hyland GJ. Physics and biology of mobile telephone. *Lancet* 2000; 25: 1833-1836.
4. Thamir K, Sultan M. Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance in Saudi population. *Saudi Med J* 2004; 25: 732-736.
5. Ozturan O, Erden T, Miman MC, Kalcioğlu MT, Oncel S. Effects of the electro magnetic field of mobile telephones on hearing. *Acta Otolaryngol* 2002; 122: 289-293.
6. Bortkiewicz A, Zakladu FP. A study on the biological effects of exposure to mobile phone frequency EMF 67. *Med Pr* 2001; 52: 101-106.
7. Valberg P, Deventer T, Repacholi M, Workgroup Report. Base Stations and Wireless Networks-Radiofrequency (RF) Exposures and Health Consequences. *Environ Health Perspect* 2007; 115: 416-424.
8. Blettner M, Berg G. Are mobile phones harmful? *Acta Oncol* 2000; 39: 927-930.
9. Knave B. Electromagnetic fields and health outcomes. *Ann Acad Med Singapore* 2001; 30: 489-493.
10. Galeev AL. Effects of the microwave radiation from the cellular phones on humans and animals. *Russ Fiziol Zh Im I M Sechenova* 1998; 84: 1293-1302.
11. Independent Expert Group on Mobile Phones. Mobile phones and health. Didcot, Oxon: National Radiological Protection Board; 2000. p. 159.
12. Occupational Safety of Health Administration. 1910.95 CFR Occupational Noise Exposure: Hearing Conservation Amendment (Final Rule). *Fed Regist* 1983; 48: 9738-9785.
13. Oktay MF, Dasdag S. Effects of intensive and moderate cellular phone use on hearing function. *Electromagn Biol Med* 2006; 25: 13-21.
14. García Callejo FJ, García Callejo F, Peña Santamaría J, Alonso Castañeira I, Sebastián Gil E, Marco Algarra J. Hearing level and intensive use of mobile phones. *Acta Otorhinolaringol Esp* 2005; 56: 187-191.