EEG FREQUENCY ANALYSIS OF 60 HZ MAGNETIC FIELD EXPOSURE WITHIN THE MRI

The effects of human exposure to power-line frequencies (50-60 Hz) are a major concern, particularly occupational exposure to workers, which can feature high electromagnetic field strengths coupled with long- duration exposures. Many studies focus on the extent to which workers or the general public are exposed to powerlines in terms of magnetic field (MF) strength and duration and much research centres on its potentially carcinogenic effects. However, the current literature lacks comprehensive measures of the neurobehavioral, physiological and cognitive impact of frequencies within this range. Furthermore, although the long-term effects such as carcinogenesis have been investigated, the more subtle outcomes of MF exposure have not been examined in detail. For example, there may be a risk that small changes in brain activity such as balance, proprioception, reaction speed, judgement and fine motor control may be amplified when working at elevated high voltage lines. There is therefore a need for more objective analyses, especially for utility workers, of environmentally relevant parameters when investigating powerline frequency effects.

Previously, our group has conducted work to explore the effects of 60 Hz, 1800 μT MF exposure on human neurophysiology. Subtle effects on postural tremor (increase in the 7-12 Hz range) and standing balance (significant decrease in oscillations amplitude) were found. Recently, we have also conducted studies to examine the effects of a 1 hour, 60 Hz, 3000 μT MF, and have found that brain functional activation was significantly modulated in both a tapping task and a mental rotation task as measured by functional magnetic resonance imaging (fMRI). To further explore these results, a new phase of this project is currently initiated in which electroencephalography (EEG) is complementing MRI in order to compensate for the limited temporal resolution of MRI (on the order of seconds).

Consequently, we are currently investigating the effects of a 60 Hz MF using our 3T MRI unit as an active exposure system (by using custom MRI sequences programmed by Dr Jean Théberge, Medical Physicist at Lawson) at a highest level of amplitude (up to 8 mT) in human subjects, while recording EEG. The EEG was recorded using a 64-channel MRI compatible cap. Continuous (90 s) and intermittent (150 cycles of 2 s of exposure, then 1 s without exposure) 60 Hz MF exposure were tested. Frequency analysis was performed on the recorded EEG to evaluate the possibility to analyze EEG data acquired in humans during exposure.

We will be the first to our knowledge to demonstrate that EEG during 60 Hz exposure within the MRI environment can be examined without distortion by the MR environment. Therefore, future powerline research can be directed towards more objective measures of neurophysiological and cognitive effects using simultaneous technologies such as fMRI, EEG and electromyography (EMG). Moreover, observing effects during acute exposure may help validate or determine regulatory limits for MF field strength.