Noninvasive Technique for Measurement of Heartbeat in Zebrafish Embryos Exposed to Electromagnetic Fields at 27 GHz

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Abstract : The new fifth generation technology (5G), which should favor high data-rate connections (1Gbps) and latency times lower than the current ones (<1ms), has the characteristic of working on different frequency bands of the radio wave spectrum (700 MHz, 3.6-3.8 GHz and 26.5-27.5 GHz), thus also exploiting higher frequencies than previous mobile radio generations (1G-4G). The higher frequency waves, however, have a lower capacity to propagate in free space and therefore, in order to guarantee the capillary coverage of the territory for high reliability applications, it will be necessary to install a large number of repeaters. Following the introduction of this new technology, there has been growing concern in recent years about the possible harmful effects on human health and several studies were published using several animal models. This study aimed to observe the possible short-term effects induced by 5G-millimeter waves on heartbeat of early life stages of Danio rerio using DanioScope software (Noldus). DanioScope is the complete toolbox for measurements on zebrafish embryos and larvae. The effect of substances can be measured on the developing zebrafish embryo by a range of parameters: earliest activity of the embryo's tail, activity of the developing heart, speed of blood flowing through the vein, length and diameters of body parts. Activity measurements, cardiovascular data, blood flow data and morphometric parameters can be combined in one single tool. Obtained data are elaborate and provided by the software both numerical as well as graphical. The experiments were performed at 27 GHz by a no commercial high gain pyramidal horn antenna. According to OECD guidelines, exposure to 5G-millimeter waves was tested by fish embryo toxicity test within 96 hours post fertilization, Observations were recorded every 24h, until the end of the short-term test (96h). The results have showed an increase of heartbeat rate on exposed embryos at 48h hpf than control group, but this increase has not been shown at 72-96 h hpf. Nowadays, there is a scant of literature data about this topic, so these results could be useful to approach new studies and also to evaluate potential cardiotoxic effects of mobile radiofrequency.

Keywords : Danio rerio, DanioScope, cardiotoxicity, millimeter waves.
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