Electron microscopic study of folliculogenesis after exposure to electromagnetic field

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Abstract

Introduction: Humans are continuously exposed to harmful environmental factors, such as electromagnetic fields (EMF) produced by home appliances, diagnostic tools and industrial instruments. The adverse effects of electromagnetic field on biological systems has been shown by epidemiologic and experimental studies. However, the results about the exact mechanism of its actions and its effects on different organs are not conclusive. The present study is designed to investigate morphological effects of EMF on ovarian follicles, at cellular level, using electron microscope.

Materials and Methods: For this purpose, 30 adult female wistar rats were used (15 as control and 15 as experimental group). The rats in experimental group were exposed to 3 milli Tesla EMF for 4h/day for 4 months. After the experimental period, the ovaries eblated from both experimental and control groups, after proper fixation and processing, the thin sections were studied by transmission electron microscopy (TEM). Morphometric studies were carried out on electron micrographs using measurements and counting techniques. The data were analysed using students T- test.

Results: Electron micrographs revealed that in EMF exposed group, in comparison to control group, the oocytes had shrunk and the thickness of zona pellucida and the number of penetrated microvilli were significantly ($P<0.001$) reduced (4.47 ± 0.42 vs. 3.24 ± 0.25 as 9.8 ± 0.56 vs. 4.13 ± 0.83 respectively). In the cytoplasm of oocytes from the experimental group the lamella were condensed. The granulosa cells from the EMF-exposed rats showed nuclear condensation and chromatin margination and several vacuoles appeared in their cytoplasm. The other morphological changes inclued; disappearance of mitochondrial cristaes, appearance of apoptotic signs such as separation from neighboring cells and appearance of apoptotic bodies. These changes were associated with an increase of macrophages.

Conclusion: Our results suggest that EMF-exposure inhibits follicular growth and oocyte maturation by affecting cellular function, membrane changes and inducing apoptosis. It is concluded that EMF exposure, by the above mechanisms, could interfere with normal process of oogenesis and lead to subfertility.

Key Words: Electromagnetic field (EMF), Transmission electron microscope (TEM), Apoptosis, Rat, Ovary, Follicle, and Granulosa cell.

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