

EFFECT OF ELECTROMAGNETIC FEILD ON BOUNDARY TISSUE OF THE SEMINIFEROUS TUBULES OF RAT : A LIGHT AND TRANSMISSION ELECTRON MICROSCOPE STUDY

A. A. Khaki*, N.F.Hosseini**, T.C. Nag***, M. Kafshnoochi *, H. Montazam*, A. Khaki**

Department of Human Anatomy, Bonab Islamic Azad University, Bonab*, Tabriz Islamic azad University, Tabriz**
All India Institute Of Medical Science, *** Ansari Nagar, New Delhi-110029, India

Abstract: Human beings are unavoidably exposed to ambient electro magnetic fields (EMF) generated from various electrical gadgets and from power transmission lines. Controversy exists about the EMF effects on various organs. One of the critical issues is that EMF may adversely affect the reproductive system. To examine this, rat pups (30) were exposed to 50 Hz EMF (non-ionizing radiation) during in utero development (approximately 3 weeks) and postnatal life (5 weeks). Groups of exposed rats were subsequently left in an environment free of EMF in order to see recovery, if any, from changes induced by EMF on boundary tissue of the seminiferous tubules. The materials were processed and observed under light and transmission electron microscope. In the experimental rats, boundary tissue was found disrupted in its various layers. It showed infoldings, which were perhaps due to the loss of collagen and reticular fibrils from the inner and outer non-cellular layer. The myoid cells showed few polyribosomes, pinocytotic vesicles and glycogen granules. Their mitochondria were without cristae. The connections between individual myoid cells were apparently lost. There were signs of recovery in the boundary tissue following withdrawal from EMF exposure. The empty spaces between the various layers disappeared and most cytoplasmic organelles reappeared. The results suggest that EMF exposure causes profound changes in the boundary tissue of the seminiferous tubules. On long term exposure, it could result in damage, which may lead to subfertility and hence should be avoided.

Key words: electromagnetic fields; testes; boundary tissue; seminiferous tubules; rats; electron microscopy.

INTRODUCTION

In an industrialized society the ambient electromagnetic fields (EMF) are encountered everywhere and cause unavoidable exposure. With the increased use of power transmission lines and modern electrical gadgets, concern about public health due to chronic exposure to EMF has come into a sharper focus. The transport and use of electricity generates both electric and magnetic fields with a wide spectrum of frequencies, intensities and waveforms. The power frequency for electric transmission and distribution for domestic services is 60 Hz in North America and 50 Hz in Europe. The number of visual display terminals (VDT), domestic and industrial gadgets using similar frequencies are on an increase. Accordingly, much of the mammalian reproductive research has focused on these frequencies because of their ubiquitous presence in the environment. Studies have revealed that exposure to EMF gives rise to changes in spermatogenic, Sertoli and Leydig cells as well as in the blood vessels. EMF is a possible source of carcinogen.^{1,2,3} However, little is known about the effect of EMF on the cytoarchitecture of the boundary tissue of the seminiferous tubules, which performs a number of crucial functions, e.g., mechanical support and transport of nutrients for the spermatozoa^{4,5} and maybe in sperm discharge by maintaining a certain pressure on the tubule.^{6,7} found that low frequency intermittent EMF exposure during critical prenatal period for neurobehavioral sex differentiation can demasculinize male scent seeking behavior and increase weight of accessory sex organs in adulthood. No association between occupationally related categories of EMF exposure and male subfertility, evaluated by sperm morphology, motility and concentration was found. These findings do not support the deleterious effects on male reproductive health from exposure to magnetic fields⁸ Lokhmatov⁹ in his works on the effect of EMF on the testes, found premature reproductive

aging caused by destruction and desquamation of spermatogenic layers in the seminiferous tubules and reduction in the number of testosterone producing cells. The effects of 50 Hz magnetic fields on mouse spermatogenesis using flow cytometric analysis revealed cytotoxic and cytostatic effect on the differentiating spermatogonia¹⁰. Most of the studies mentioned above were done on transitory and temporary effect of EMF testes. It is not exactly possible to study the effects on human population exposed to special kind of occupation, e.g., some industries, MRI, X-ray radiation, radar, military, nuclear power centre etc.

In this study male rats were exposed to 50 Hz EMF (non-ionizing radiation) during development (prenatal as well as postnatal) in a EMF Producing system. Groups of exposed rats were subsequently left in an unexposed situation in order to see recovery, if any, from the changes effected by EMF exposure. The study becomes significant because electromagnetic waves are often encountered everywhere and a large part of global population is constantly exposed to a variety of these radiations due to professional, residential, medical, industrial or other uses.

MATERIAL AND METHODS

Animals and Maintenance: A total of 40 female Wistar rats (about 15 week-old) procured from animal house were used for the study. Rats of the same sex were housed together (five per cage) and kept in quarantine for a week to rule out any disease. Rats were fed on compact food in the form of granules and water. This food consisted of all essential ingredients including vitamins and minerals. Environmental conditions (temperature and humidity) in all animal holding areas were continuously monitored. Temperature was maintained in the range of 20°C - 30°C and relative humidity was monitored at 35-60%. Fluorescent light was provided on a 12 h light/dark cycle and put on from 8 a.m. till 8 p.m. Lights were located at distance of three meters from the cages so that these did not interfere with the EMF of the experimental design^{11,12}.

EMF Producing System: The equipment was based on Helmholtz coil which works following Fleming's right hand rule. It produced an alternate current of 50 Hz frequency creating an EMF of 80 G

Correspondence : Dr. A.A .Khaki, 1 Etekally Alley South shariaty st., Tabriz 51388, Iran. Fax : 0098-411-3304155.

e-mail : aakhaki@canada.com