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Bio-geometrical shapes: a new option for protection against neurodegenerative insult of Wi-Fi radiation

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This work goaled to assess the damaging impact of Wi-Fi signals on rat brain and to explore the protective function of a set of Bio-Geometrical shapes against the neurodegenerative outcomes resulting from the exposure to this radiation. The exposed group showed significant drop in serum melatonin while, it revealed significant elevation in serum HSP-70 relative to the controls. Oxidative stress in the brain was documented by the increased MDA and decreased GSH contents of brain tissue. The use of the Bio-Geometrical shapes along with exposure could cope the hazards of EMF. This was evidenced by the increasing melatonin and the decreasing HSP-70 levels as well as the restoring of brain oxidative/antioxidant homeostasis. Conclusively, this investigation shed light on the possible protective role of Bio-Geometrical shapes against detrimental effects of Wi-Fi radiation on rat brain.

Keywords: Wi-Fi radiation; Brain; Bio-Geometrical shapes; Antioxidant defense system; Rats.

INTRODUCTION

There is wide spread concern regarding the adverse events on human health induced by exposure to different types of electromagnetic fields (EMF) (Challis 2005). The environmental wireless device (Wi-Fi) or wireless internet access device (WIAD) has higher frequency (HF) ranges and longer exposure times than wireless phones (Viel et al., 2009). Thus, the health hazards related to these devices might be different and probably greater than mobile phones (MB). As the health impacts of RF radiation are still not fully understood, the council of Europe suggested restriction usage of the internet access and cell phone in all schools to protect youth from the harmful radiation (Watson 2011).

Global system for mobile telecommunications (GSM) - modulated 900 MHz signal, functions as co-stressor for oxidative degeneration of neural cells (Chavdoula et al., 2010). Paulraj and Behari (2006) observed that the exposure to 2.450 MHz RF radiation causes DNA damage in rat brain cells. In line with this finding, Dasdag et al., (2015) reported that RF radiation emitted from Wi-Fi equipment can affect micro RNA expression in brain tissue. Also, the study of Davanipour et al., (2007) suggested that EMFs exposure may be linked with high risk of neurodegenerative diseases.

Bio-Geometry is a science which uses shapes, colors, motion, orientations and sounds to balance the qualities of all levels of energy in the surrounding environment. It is one of the new energy quality sciences that emerged in architecture as a response to the hazards of modern technology. Bio-Geometry was initiated by the Egyptian architect Ibrahim Karim after more than 30 years of research (Karim 2007). Bio-

Geometry energy quality balancing solutions are being applied to architecture, telecom networks, industrial design (Sharaf et al., 2014).

The present study was initiated to estimate the oxidative burden of Wi-Fi radiation on rat brain and to investigate the protective role of a designed set of Bio-Geometrical shapes against the neurodegenerative insult of this radiation.

MATERIALS AND METHODS

Wireless internet access device

Two commercially available Linksys wireless-N300 (WAP300N-EE), operating at 802.11.g standards were used in this study. The output power was 95 mW average, as equivalent iso-tropically radiated output power. The maximum specific absorption rate (SAR) of the wireless gateways in the conformity assessment test was 0.091 W/kg.

Bio-Geometrical Shapes

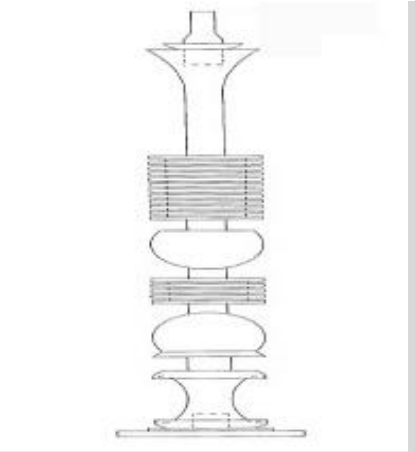

Figure.1: Hamburg acrylic stand.

Bio-Geometric Hamburg acrylic stands form shown in (Figure 1) was designed by Ibrahim Karim and put in the front of Wi-Fi router to harmonize the waves and reduce the harmful effects. Paper form in (Figure 2) was designed by Mohamed Elsawy and put on Wi-Fi router antenna to harmonize the the harmful effects of waves. Bio-Geometric acrylic corner stand form shown in (Figure 3) was designed by Ibrahim Karim to enhance the energy quality of space. Bio-Geometric acrylic cube form shown in (Figure 4) was designed by Ibrahim Karim and put beside the animal cage to enhance the energy quality of space and Plastic form shown in (Figure 5) was designed by Mohamed Elsawy and put on Wi-Fi router antenna to harmonize the harmful effects of waves.

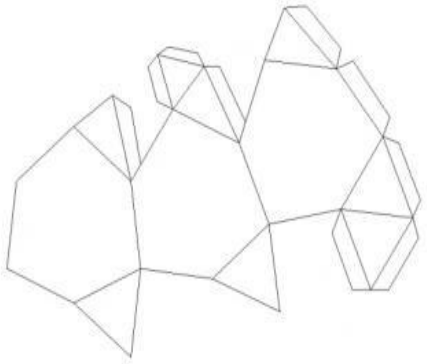

Figure.2: Sawy paper form.

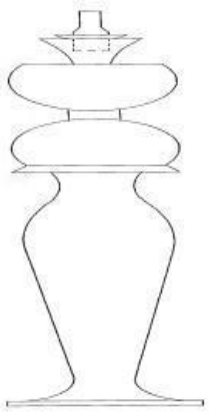

Figure.3: acrylic corner stand

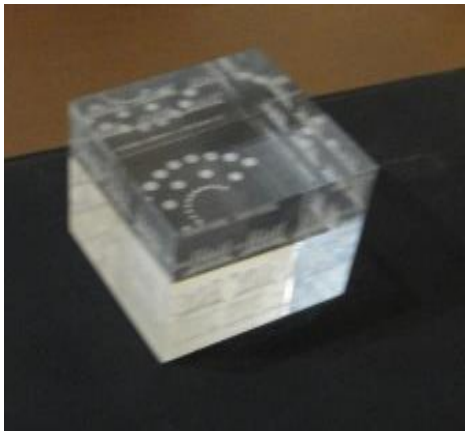

Figure.4: acrylic cube

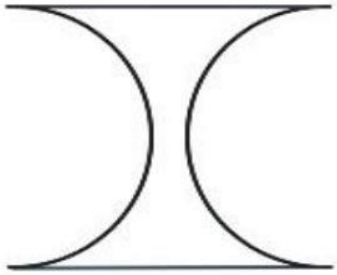

Figure.5: plastic form

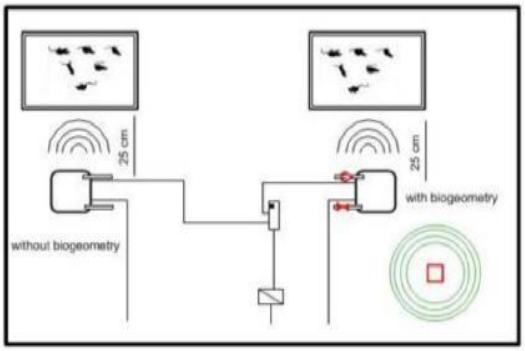

Figure.6: Planned diagram of the study design

Animals and Experimentation

Eighteen adult female albino rats of the same age (3 months), and weight (130 g), were obtained from a breading stock maintained in the Animal House of the National Research Centre, Giza, Egypt. The animals were housed in a controlled environment (22-25˚ C and 12 hours light-12 hours dark) with food and water freely available. The study protocol conformed to the ethical guidelines of the Ethics Committee of Medical Research at the National Research Centre, Giza, Egypt. After the acclimatization period, the animals were randomly assigned into three equal groups as follow: Group I; six adult rats were housed in the ordinary plastic cage in a separate room away from any electromagnetic waves contamination and served as control group, Group II; six adult rats were housed in a similar cage placed in another room mounted with a Wi-Fi router (wireless router). These rats were exposed for 24 h over a period of 17 weeks to the electromagnetic radiation emitted from the Wi-Fi router (exposed group) and Group III; six rats were housed in a third similar cage placed in a third room mounted with a similar Wi-Fi router (wireless router), over the above mentioned period but the rats were protected by a designed Bio-Geometrical shapes (set of shapes) (protected group).

The two Wi-Fi routers were placed at a distance of 25 cm from each cage; the rooms housing the cages are identical to each other in shape and dimensions but located away from each other by a distance not less than 30 m (Figure 6).

Sample Collection and preparation

At the end of the experimental period, blood samples were withdrawn from retro-orbital plexus of the individuals of each group, after being fasted for 12 hours. Serum samples were separated and stored at -20 ºC for biochemical analysis of melatonin and heat shock protein-70 (HSP-70). Then, all animals were sacrificed by cervical dislocation following ether anesthesia and each brain was quickly excised, washed in ice-cold saline, bottled dry and divided sagitally into two halves. One half was prepared for histopathological examination following the method of Banchroft et al., (1996) and the other half was prepared according the method of Tsakiris et al., (2004) for evaluation of oxidant/antioxidant parameters (MDA and GSH).

Biochemical analyses

Enzyme-linked immunosorbent assay (ELISA) kits (WKEA MED supplies crop Co., Ltd (China) used for quantitative determination of rat melatonin (MT) and heat shock protein-70 levels in serum according to manufacturer's instructions. Malondialdehyde (MDA) content in the brain was quantified using the thiobarbituric acid reactive substances method (Uchiyama and Mihara, 1978). Reduced glutathione (GSH) content in the brain was determined according to the method of Ellman(1959).

Statistical analysis

SPSS VERSION 13 was used for the statistical procedures.Statistical significance of difference was determined using analysis of variance (one way ANOVA). A p value < 0.05 was considered as significant. Percent of change in comparison with the corresponding control group was calculated according to the following formula:

$$\% \text{ difference} = \frac{\text{Treated value} - \text{Control value}}{\text{Control value}} \times 100$$

RESULTS AND DISCUSSION

Biochemical Results

The results shown in Table 1 indicated that the group of rats that exposed to Wi-Fi radiation experienced remarkable suppression in serum melatonin level (-21.5 %) relative to the control counterparts. Meanwhile, the rats in the protected group showed significant enhancement ($p< 0.05$) in serum, melatonin level (42.5 %) versus the exposed ones. On the opposite side, the exposed group displayed significant elevation ($p< 0.05$) in serum HSP-70 level (207.2 %) in respect with the control group, while the protected group exhibited significant decline ($p< 0.05$) in HSP-70 serum level (-39.4 %) as compared to the exposed group (Table 1).

Brain content of MDA revealed significant rise ($p< 0.05$) in the exposed group (24.87 %) relative to the control ones. However, MDA content in the brain of the protected group demonstrated significant drop ($p< 0.05$) (-15.5 %) versus the exposed group (Table 1). In contrast, brain GSH content manifested significant regression ($p< 0.05$) in the exposed group (-28.04 %) relative to the control group but it exhibited significant amplification ($p< 0.05$) in the protected group (38.6 %) in comparison with the exposed ones Table 1.

Histopathological Findings

Optical micrograph of brain tissue section of rat in the control group revealed normal histological structure of subiculumneoronal cells in the hippocampus (Figure 7a). Also, normal histological feature of fascia dentate and hilus neuronal cells in the hippocampus has been shown in the optical micrograph of brain tissue section of rat in the control group (Figure 7b).

Figure (7c) represented photomicrograph of brain tissue section of rat in the group exposed to Wi-Fi radiation showing nuclear pyknosis and degeneration in the neurons of subiculum of the hippocampus. As well, nuclear pyknosis and degeneration in the neurons of fascia denate in the hipoocampus have been observed in the photomicrograph of brain tissue section of rat in the exposed group (Figure 7d).

Optical micrograph of brain tissue section of rat in the protected group by using Bio-Geometrical shapes showed normal histological structure of subiculum neurons of the hippocampus (Figure 7e). Also, normal histological structure of fascia denate and hilus neurons of the hippocampus has been noticed in the optical micrograph of brain tissue section of rat in the group protected by Bio-Geometrical shapes (Figure 7f).

In the current experiment, the methodology used imitating the real life conditions, or the situations present in our homes, whereas the whole body was exposed to irradiation from RF of WIADs placed in the house. In the current study, melatonin level in serum was found to be decreased significantly in Gr II compared to that of Gr I ($p<0.05$). Krewski et al., (2001) stated that exposure to electromagnetic radiation leads to a reduction in serum melatonin level in rats. Also, Wang (1989) found that people who are occupationally exposed to EMFs, suffered from a reduction in circulating MT level. Herein, we suppose that Wi-Fi router radiation induces an oxidative stress state in the brain of rats in Gr II (exposed group) by increasing brain lipid peroxidation product (MDA) and decreasing the brain content of the anti-oxidant glutathione (GSH). MT plays a modulator role on ROS and stress markers in the brain (Nazıroğlu et al., 2012) hippocampus (Köylü et al., 2006) in rats exposed to 2.45 GHz, as MT can directly scavenge free radicals (Reiter et al. 2000). Thus, the remarkable inhibition of serum MT level in rats exposed to Wi-Fi radiation could be explained by the exhaustion of melatonin in sweeping free radicals produced as a result of Wi-Fi radiation exposure. Moreover, the resulting decrease in serum MT level in the exposed group might be due to the degenerative insult of Wi-Fi radiation on MT producing cells in the pineal gland (Wilson et al., 1981). In the present study, HSP-70 was found to be increased significantly in the group of rat exposed to RF radiation of the Wi-Fi router (Gr II), when compared with the control group (Gr I). López-Furelos et al., (2016) detected significant differences in HSP-90 and HSP-70 in cerebellar hemispheres of the group of rats exposed to EMF signals at 900 and 2450 MHz, compared to the control group. Also, Yang et al. (2012) concluded that adult male rats exposed to 2.45 GHz (6 W/kg) evoke a stress response in its hippocampus *via* increasing expression of HSP-27 and HSP-70.

Table 1: Melatonin, HSP-70 in serum and prooxidant/antioxidant markers in brain tissue of female albino rats of the three studied groups (Results are expressed as means ± SE for 6 rats/groups)

Melatonin in Serum (ng/l)		HSP-70 in serum (ng/l)	MDA in brain (nmol/g tissue)	GSH in brain (µmol/g tissue)
Group I (Control group)	6.26±0.38	14.16±1.16	654.58±21.29	28.13±1.5
Group II (Exposed group)	4.91±0.39 (-21.5%)	43.5±4.31[a] (207.2%)	817.4±19.39[a] (24.87%)	20.24±1.33[a] (-28.04%)
Group III (Protected group)	7.0±0.57[b] (42.5%)	26.33±1.68[ab] (-39.4%)	690.34±26.58[b] (-15.5%)	28.06±1.33[b] (38.6%)

a: Significant difference at P<0.05 in comparison with the control group.

b: Significant difference at p<0.05 in comparison with the exposed group. %: Percent of change in comparison with the corresponding group.

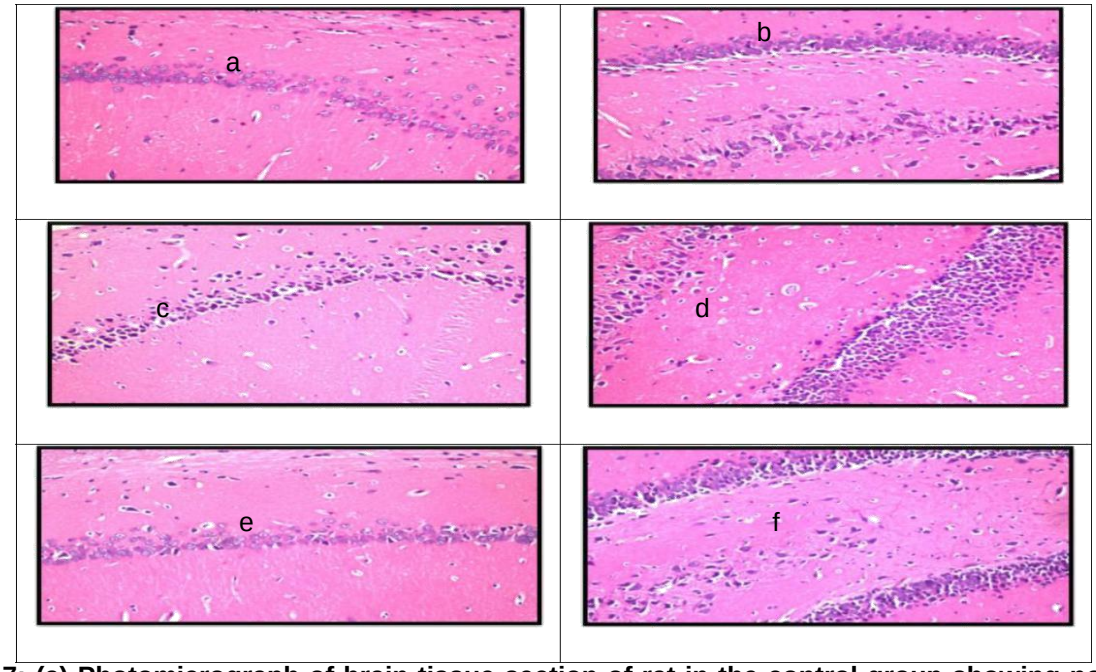

Figure 7: (a) Photomicrograph of brain tissue section of rat in the control group showing normal histological structure of subiculum neuronal cells in the hippocampus (H&E × 40); (b) Photomicrograph of brain tissue section of rat in the control group showing normal histological structure of fascia dentate and hilus neuronal cells in the hippocampus (H&E × 40); (c) Photomicrograph of brain tissue section of rat in group exposed to electromagnetic waves (Wi-Fi) showing nuclear pyknosis and degeneration in the neurons of subiculum of the hippocampus (H&E × 40); (d) Photomicrograph of brain tissue section of rat in group exposed to electromagnetic waves (Wi-Fi) showing nuclear pyknosis and degeneration in fascia dentate neurons of the hippocampus (H&E × 40); (e) Photomicrograph of brain tissue section of rat in group protected by Bio-Geometrical shapes showing normal histological structure of neurons in subiculum of hippocampus (H&E × 40); (f) Photomicrograph of brain tissue section of rat in group protected by Bio-Geometrical shapes showing normal histological structure of neurons of fascia dentate and hilus in the hippocampus (H&E × 40).

In view of the present data, significant enhancement in brain malondialdehyde (MDA) content in the group of rats exposed to Wi-Fi radiation RF range (Gr II) whereas, brain glutathione (GSH) content was significantly reduced in the same group, relative to those of the referent group (Gr I). So exposure to Wi-Fi radiation induced a state of oxidative stress through imbalance in the pro-oxidant / antioxidant parameters. These findings coincide with those of Çelik et al., (2016) who found that Wi-Fi induces oxidative stress in the brain and liver of the developing rats, as indicated by the reduced value of GSH-Px, GSH, vitamin A and E. Moreover, this research group observed that the brain seems to be more sensitive to oxidative injury compared to liver. EMR-induced oxidative stress in the brain was also detected by Çetin et al., (2014) in growing rats despite their rats were exposed to lower frequencies 900 MHz and 1800 MHz for 60 minutes/day during pregnancy and neonatal development. Also, Köylü et al., (2006) detected lipid peroxidation in the brain cortex and hippocampus of the microwaves cellular phones (900 MHz) exposed rats through the increased MDA content.

In favor of this hypothesis, Ilhan et al., (2004) recorded a marked oxidative burden in brain tissues of rats exposed to 900 MHz signal for GSM (SAR of 2 Wkg−1 in the brain) for 7 days.

In another experimental model of guinea pigs, Meral et al., (2007) estimated the impact of GSM signal (890–915 MHz EMF, SAR 0.95Wkg−1, for 12 h/day for 30 days) on the oxidative stress axis, by detecting MDA, GSH, catalase (CAT) and vitamin A, D3, and E values in both brain and blood. These investigators recorded enhancement in MDA, and a drop in both GSH and CAT values in brains, without any change in vitamins concentration. Thus, they suggested that RF exposure can promote suppression of the antioxidant systems, due to the increased lipid peroxidation and formation of free radicals. Gong et al., (2013) reported similar results and concluded that acute and chronic EMF irradiation initiate neurologic damage in rat hippocampus by inducing peroxidation damage, neuronal apoptosis, impaired learning and memory.

The histopathological findings of the current investigation support the link between the exposure to Wi-Fi radiation and the neurodegenerative diseases. As the photomicrograph of brain tissue section of rat exposed to Wi-Fi radiation (Gr II) revealed nuclear pyknosis and degeneration in the neurons of subiculum and fascia dentate in hippocampus.

In this study, we use a set of designed shapes based on Bio-Geometric principles to modulate the insult of HF-EMF emitted from the Wi-Fi router on rats (Gr III). The present data indicated that these shapes could revert all the measured parameters positively, and succeed in retrieving the effects of HF-EMF radiation on the histological feature of rat brain. We postulate that these shapes could transmute the effects of energy induced by EMF and overcome the insults of EMR in the protected group of rats (Gr III), through supporting of self-healing and empowering the protective antioxidant defense system. So, the pineal gland regained its ability to produce melatonin as its level showed a normal value in serum. Hence, MT began to exert its potent effect as powerful antioxidant in scavenging ROS in rat brain and reversing the effects of Wi-Fi radiation on HSP-70, MDA and GSH in the protected group. The optical micrograph of rat brain tissue section appreciated these findings. As, the normal histological feature of subiculum neurons and fascia dentate as well as hilus neurons of the hippocampus has been observed in the microscopic investigation of brain tissue section of rat in the protected group.

In the light of the current results, we concluded that Wi-Fi router RF radiation induced degenerative effects on rat brain, and evoked a decrease in serum melatonin and amplified HSP-70.Also, it produced oxidative stress as it unregulated oxidative stress marker MDA, and decreased GSH contents in the brain. The use of Bio-Geometric shapes could abrogate the harmful effects of energy induced by EMF (Wi-Fi router RF radiation) through favoring of self- healing and intensifying the antioxidant defense mechanism. These Bio-Geometrical shapes succeeded in reversing the aberrant effects of Wi-Fi router RF radiation. Hence, it is mandatory to proceed with intense studies on this issue.

CONCLUSION

In the light of the current results, we concluded that Wi-Fi router RF radiation induced degenerative effects on rat brain, and evoked a decrease in serum melatonin and amplified HSP-70. Also, it produced oxidative stress as it unregulated oxidative stress marker MDA, and decreased GSH contents in the brain. The use of Bio-Geometric shapes could abrogate the harmful effects of energy induced by EMF (Wi-Fi router RF radiation) through favoring of self- healing and intensifying the antioxidant defense mechanism.

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CONFLICT OF INTEREST

There are no conflicts of interest.

ACKNOWLEGEMENT

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AUTHOR CONTRIBUTIONS

NES participated actively in invention of the scientific idea, arrangement of the experimental steps, analyzing the data, writing the manuscript, revising it critically and approving the final version, MSE participated in invention of the scientific idea, designing the Bio-geometrical shapes and arranging them in the experimental steps, HHA participated actively in conducting the experimental steps, performing the necessary biochemical analyses, writing the manuscript, revising it critically, approving the final version and submitting the manuscript to journal, FMM, NMH and AME revised and approved the final version.

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