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## **Effects of Exposure to Cellular Phones 950 MHZ Electromagnetic Fields on Progesterone, Cortisol and Glucose Level in Female Hamsters (*Mesocricetus auratus*)**

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### **ABSTRACT**

The aim of present study was to investigate the cellular phones emitted EMFs (Electromagnetic fields) effect on serum progesterone, cortisol and glucose concentration in exposed female hamsters. Seventy two female golden hamsters (mature and non-pregnant) were used. The animals were divided into three groups: group 1- the control group without any EMF exposure; group 2- the short-term EMF exposure (10 day, 3 h daily) and group 3 - the long-term EMF exposure (60 day, 3 h daily). The 950 MHZ EMFs emitted by the antenna of cellular phones (Specify: ON, SAR: 0.60 week kg<sup>-1</sup>) was produced for short- or long- term (group 2 and 3), respectively. Exposing to 900 MHZ EMF caused decreases in progesterone (p<0.01) and increases in cortisol for both exposed groups (short-term and long-term) (p<0.01) in comparison with control group. Group exposed for 60 days had significantly higher blood glucose rate in comparison with control or short-term exposed groups. May, 950 MHZ EMFs caused stressful condition, cortisol releasing and subsequent hyper-glycemia in long-term exposing. Also, adrenal and reproductive glands may affect by 950 MHZ EMFs and caused changes in serum progesterone rate. It was concluded that short-or long-term exposure to 950 MHZ may cause progesterone suppressing and cortisol releasing but this frequency only in long-term exposure could cause hyper-glycemia in hamster as a laboratory model.

**Key words:** Cellular phone, electromagnetic field, radiation, cortisol, progesterone

### **INTRODUCTION**

Nowadays with extension and progress in telecommunication, application of cellular phones and power transmitted lines, exposing to Electromagnetic Fields (EMF) is a global hazardous problem. EMFs can increase temperature of live tissue and has thermal effect on bio-organisms. These effects can changes membrane electric potential and ion distribution and finally can disrupts biochemical reactions in cells (Lee *et al.*, 2004).

EMSs have considerable effect on endocrine system (Koyu *et al.*, 2005; Shahryar *et al.*, 2008). Epidemiological studies had documented that EMFs caused cortisol elevation (Radon *et al.*, 2001). Magnetic Fields (MF) trigger lipolysis and glycogenolysis and subsequent glucagon and cortisol elevation in rodent model (Gorczyńska and Wegrzynowicz, 1991; Chemysheva, 1990). Shahryar *et al.* (2008) and Lotfi and Shahryar (2009) had showed that EMFs emitted by cellular phone can change serum testosterone and lipid concentrations in exposed male hamsters. Cortisol is a hormone released from adrenal gland, is a stress indicator and it has been recognized that its level is elevated in humans exposed for a long time to EMFs (Vangelova *et al.*, 2007). Other studies

did not reveal this effect (Djeridane *et al.*, 2008). Evidences of the detrimental effect of mobile phones on male fertility are still equivocal as studies have revealed a wide spectrum of possible effects ranging from insignificant effects to variable degrees of testicular damage (Agarwal, 2007). Cakir *et al.* (2003) had reported that serum progesterone rate had increase in exposure to 50 Hz MF in female rodent. But Al-Akhras *et al.* (2006) reported that MFs could lower progesterone releasing. Shahryar *et al.* (2008) had reported exposure to cellular phones EMF can elevate sex hormone (testosterone) in male hamsters and changes secondary sex ratio (Aghdam Shahryar and Lotfi, 2010). Aspects on cellular phones EMF on progesterone and stress hormone (such as cortisol) in rodent are not studied clearly. The aim of present study was to investigate on cellular phones emitted EMFs (Electromagnetic fields) effect on serum progesterone, cortisol and glucose concentration in exposed female hamsters.

## **MATERIALS AND METHODS**

This experiment has been done in laboratory animal room at Tehran, during summer 2010. Seventy two female golden hamsters (mature and non-pregnant) were used. They were acclimated for 1 week prior to use, maintained on a 12 h light: 12 h dark cycle in a temperature-regulated (22-23°C) animal room with continuous free access to water and feed. The animal studies were carried out in adherence to the guidelines established in the Guide for the care and use of Laboratory Animals, US Department of Health and Human Resources (NIH1985). The hamsters were kept in conditions similar to pet housing systems.

The animals were divided into three groups: group 1- the control group without any EMF exposure; group 2- the short-term EMF exposure and group 3- the long-term EMF exposure. The animals were selected and each of the exposed animals was maintained concurrently with those not exposed to EMF in separate cages. The animals included in the group 2 which were kept in separate aquarium-like glass cages covered with aluminum sheets, were under a 950 MHz EMF emitted by the antenna of cellular phones (Specify: ON, SAR: 0.60 week  $\text{kg}^{-1}$ ) 3 h daily for 10 days. The animals included in the group 3 which were also kept in separate cages, were under a 950 MHz EMF 3 h daily for 50 days.

At the end of the experiment, the animals were anesthetized and blood samples were drawn from the heart ventricle into syringes (without anticoagulants), from all the experimental groups. The serum cortisol, progesterone and glucose levels were measured by chemiluminescence immunoassay and the values of the exposure groups (groups 2 and 3) were compared with those of the control group (group 1). The data collected were subjected to an analysis of variance and any significant differences were determined. When the ANOVA revealed significant differences, Duncan's multiple range test was performed for detection of significant differences between treatment means. All the data were analyzed by ANOVA using the General Linear Model (GLM) procedures of the SAS Ver. 9.1 software.

## **RESULTS AND DISCUSSION**

Exposing to 900 MHz EMF caused decreases in progesterone ( $p < 0.01$ ) and increases in cortisol for both exposed groups (short-term and long-term) ( $p < 0.01$ ). Group exposed for 60 days had significantly higher glucose rate in comparison with control or short-term exposed groups ( $p < 0.01$ ) (Table 1).

Shahryar *et al.* (2008), show significant increases in testosterone and cortisol if male hamsters in exposure to 900 MHz EMF of cell phone. Also, Sarookhani *et al.* (2011) had reported that exposure to 950 MHz (cellular phone EMF) caused disturbs in testosterone and cortisol secretion

Table 1: Serum measures include progesterone, cortisol and glucose of female hamsters

Experimental groups	Exposure time	Progesterone (ng mL <sup>-1</sup> )	Cortisol (µg dL <sup>-1</sup> )	Glucose (mg dL <sup>-1</sup> )
Control	Without exposure	7.40 <sup>a</sup>	3.14 <sup>f</sup>	108 <sup>b</sup>
Short-term exposure	10 days exposure	5.90 <sup>b</sup>	3.74 <sup>b</sup>	112 <sup>b</sup>
Long-term exposure	60 days exposure	3.00 <sup>f</sup>	5.18 <sup>a</sup>	180 <sup>a</sup>
CV	-	5.11	6.90	4.87

Values with different letters shows significant difference between groups at p<0.01 using Duncan's multiple range test

rate in rabbits. In present study on female sex hormone (progesterone) we had observed progesterone elevation following exposure to same frequency of EMF after 10 or 60 days. Burchard *et al.* (1996) in an experiment conducted on dairy cattle, reported that exposure to electric and magnetic fields caused progesterone and cortisol elevation in milking cattle. Rodriguez *et al.* (2003) in similar study, reported that exposing to 60 Hz MF caused increase the duration of the estrous cycle and progesterone elevation in cattle. Huuskonen *et al.* (2000) reported exposure to 50 Hz MF during pregnancy didn't have significant effect on progesterone levels of female rats. Present results about progesterone are in agreement with Rodriguez *et al.* (2003) and Burchard *et al.* (1996). But in rodent, apposite to Huuskonen *et al.* (2000), in present work, we had recorded significant elevation in progesterone for exposed groups. 950 MHZ EMF in present study may with higher penetration rate and thermal effect could elevate progesterone secretion (via effects on reproductive glands) for both of short- or long- term exposing groups. Sarookhani *et al.* (2011) didn't observe any considerable change in cortisol level, after exposure to 950 MHZ EMF 2 h/day for 2 week but in present work (Table 1), 3 h exposing for 10 or 60 day could elevate cortisol level in female hamsters that is similar findings with male hamsters (Shahryar *et al.*, 2008). Also, Koyu *et al.* (2005) had showed significant cortisol elevation in rat serum following exposure to 900 MHZ emitted by artificial emitter. Another study conducted on medical staffs (in exposure to EMF producers) had reports cortisol elevation in cortisol rate. Almost all of relative findings show that EMFs specially cell phones EMFs could stimulate stress hormone such as cortisol.

Studies on low frequency Mfs suggested 50 Hz Mfs could lower blood glucose rate by Lotfi *et al.* (2011), Ocal *et al.* (2008) but Gerardi *et al.* (2008) study exposed rat to low frequency EMFs had significantly higher blood glucose rare. In present study in agreement with Gerardi *et al.* (2008), EMFs could increases blood glucose rate of exposed hamsters following 60 day exposing. With attention to stressor effects of EMFs (Vangelova *et al.*, 2007) and cortisol releasing effects of 900 MHZ EMF (Koyu *et al.*, 2005; Shahryar *et al.*, 2008) that also mentioned in present study, may 950 MHZ EMFs caused stressful condition, cortisol releasing and subsequent hyper-glycemia in long-term exposing. In other hand, adrenal and reproductive glands may affect by 950 MHZ EMFs and caused changes in progesterone rate.

## CONCLUSION

It was concluded that short-or long-term exposure to 950 MHZ may cause progesterone suppressing and cortisol releasing but this frequency only in long-term exposure could cause hyper-glycemia in hamster as a laboratory model. Further study especially for progesterone rates in exposure to EMFs in different physiological conditions (such as pregnancy, milking, etc.) are needed.

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