

SOCIEDADE PORTUGUESA
DE PROTECÇÃO CONTRA RADIAÇÕES

IV CURSO DE PROTECÇÃO CONTRA RADIAÇÕES

VIII JORNADAS PORTUGUESAS DE PROTECÇÃO CONTRA RADIAÇÕES

Colaborações Científicas:

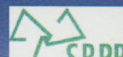
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Patrocínios:

Instituto de Desenvolvimento e Inspeção das Condições de Trabalho (IDT)
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Dias 28 e 29 de Novembro de 2001
Faculdade de Direito da Universidade Clássica de Lisboa

Colaborações Científicas:



Patrocínios:



**Intracellular calcium increase and ACTH release by corticotrophs after prolonged exposure of mice under GSM cell phone radiation and protection by electromagnetically treated saline solution (*)
(*) Tecno AO Technology**

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Objectives : To study long term effects of mobile phone radiation, as well as protective ability of electromagnetically (EM) treated saline solution in mice by measuring changes in intracellular calcium concentration $[Ca^{2+}]_i$, as well as adrenocorticotrophic hormone (ACTH) release by pituitary corticotrophs *in vitro*.

Background : Concerns about possible health effects from long term exposure to electromagnetic fields (EMF) have increased significantly with the greater number of new technologies using EMF. Especially recent introduction and exponential proliferation of wireless telecommunications devices have rekindled the debate about compatibility between man-made EMF and healthiness. EMF are stressogenic (Youbicier-Simo et al., 1997 ; 2001 ; Daniells et al., 1998; De Pomerai et al., 2000; French et al., 2001). Stress events are controlled by the hypothalamic-pituitary-adrenal axis through a hormonal cascade: hypothalamic CRH (corticotropin releasing hormone) stimulates ACTH release which itself triggers the release of glucocorticoids (cortisol, corticosterone) by the adrenals (Dayanithi and Antoni, 1989). Besides, not only calcium is an important second messenger of this hormonal cascade (Link et al., 1992), but it is also crucial for EMF coupling with living matter (Bawin and Adey, 1976; Bawin et al., 1978; Papatheofanis, 1990; Walleczek, 1992; Barbier et al., 1996). It has been reported that after electromagnetic treatment, aqueous solutions can affect crop, as well as animal physiology (Lin and Yotvat, 1988; Harari and Lin, 1989; Paterson and Chesnutt, 1994; Rai et al., 1994; Fesenko et al., 1995; Gard et al., 1995; Akimov et al., 1998; Goldsworthy et al., 1999). Herein, we investigated the stressfulness of repeated and long-term exposure to mobile phone radiation in mice, as well as the ability of EM treated saline to minimize or offset radiation-induced endpoints.

Materials and methods: The radiation source was a 900 MHz GSM cell phone (SAGEM, France) with 2 W maximum power output. It was placed horizontally with the battery downward, 4 cm underneath the cage containing mice. The magnitude of EMF on the floor of the cage was 3-12 V/m for microwaves and 40-120 V/m for extremely low frequency fields. Sealed plastic tubes were filled with treated saline solution (TecnoAO – Intl Patent) and were inserted in aluminium capsule, and this "protective unit" was installed on the outer case of the cell phone. The study was initiated with three week-old female C57BL mice (n = 15/group) held under 22 ± 2 °C, 12L-12D-19h-07h, with free access to feed and water. From 3 to 4 weeks old, mice were allowed to make used to their new environment in the absence of EMF exposure. Afterwards they were repeatedly exposed during 15 weeks (4-19 weeks old) to radiating cell phone (a call every 4 min., 24 h/day, 7days/week) fitted or not with "protective unit". Control mice were exposed with turned off cell phone. At the end of the exposure period, mice from each group were sacrificed and pituitaries were isolated and pooled. Then pituitary cell were dissociated by enzymatic digestion and cultured during 5 days. Afterwards, time-course of $[Ca^{2+}]_i$ as well as ACTH release was evaluated either in resting conditions or after stimulation by ACTH secretagogues (CRH or vasopressin: AVP). Using Fura-2 (1 μ M), the $[Ca^{2+}]_i$ measurements were performed from individual cells (n = 8-12 dishes/group; 10⁴ corticotrophs/dish) before and after exposure to either CRH (10 nM; 1 min.) or AVP (1 μ M; 2 min.). ACTH release (n = 6-7 culture dishes/group; 10⁶ corticotrophs/dish) was stimulated by 10 nM CRH during 20 min. and was measured using specific radioimmunoassays on fractions of culture medium collected every 5 min. The data for $[Ca^{2+}]_i$ were processed using the t-test. For ACTH release studies, the statistical comparisons within culture dishes were made by Quade's two-way nonparametric analysis of variance which takes into account repeated measures. Comparisons between dishes were made using Kruskal-Wallis test, followed by the U test for multiple comparisons.

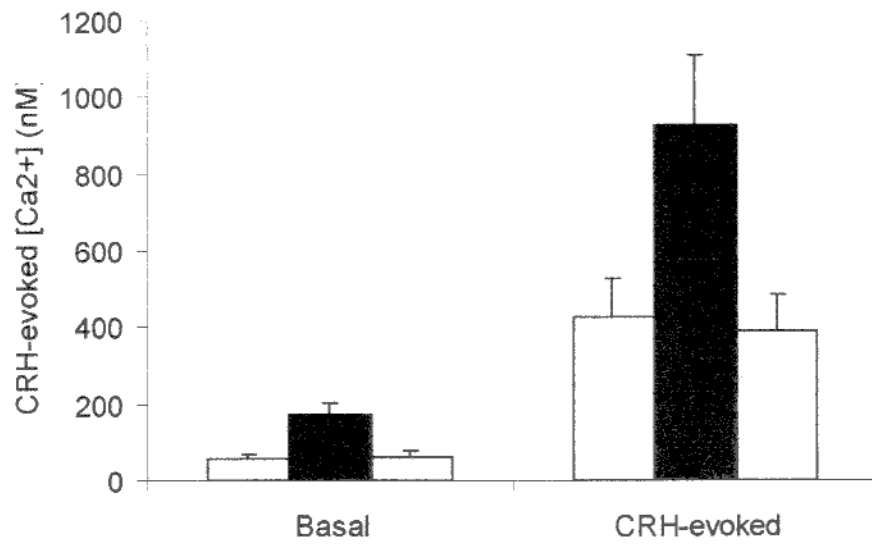
Results: The rise in $[Ca^{2+}]_i$ levels and ACTH release before and after exposure to AVP or CRH are presented in Figure 1. Briefly, resting as well as secretagogue-evoked levels of $[Ca^{2+}]_i$ or ACTH were significantly higher ($p < 0.001$) in mice exposed to active cell phone radiation than in controls, and were comparable to control values when active cell phone was fitted with "protective unit".

Conclusion: Together these findings indicate that long-term exposure to 900 MHz GSM cell phone radiation was stressful for mice and this effect was neutralized by electromagnetically treated saline solution. Consistent with literature these data also confirm that radiation-elicited disturbances were mediated by intracellular Ca^{2+} . Present findings are relevant in terms of application of the precautionary principle.

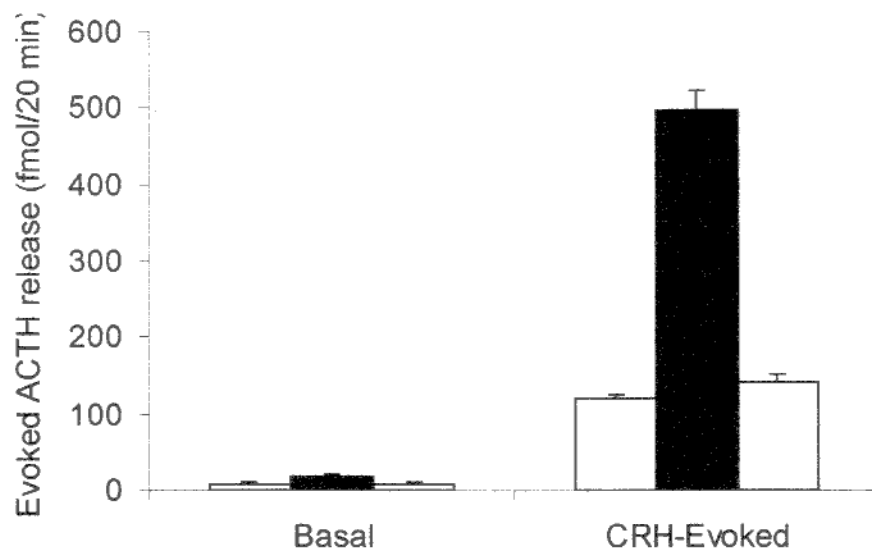
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□ Control ■ Active cell phone □ Active cell phone + EM treated saline solution



(a)



(b)

Figure : Basal and CRH-evoked intracellular calcium concentration (a) and ACTH release (b) in corticotrophs exposed to 900 MHz GSM cell phone with or without protection by electromagnetically (EM) treated saline solution.

*:P < 0.001 vs Control or active cell phone + treated saline solution