Influence of Whole Body Exposure to 915 MHz RFID on Melatonin System

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Abstract

As a part of investigation of the potential risks of 915MHz RFID to human health, we studied whether the 915MHz RFID exposure to rats can cause any changes in secretion of melatonin. For this trial, a reverberation chamber was used for animal study as a whole-body exposure system at 915 MHz RFID and its validity has been verified. The animals were exposed for 1 or 8 hrs during the day-time or the night-time, 5 days a week (whole body SAR 4W/kg) for 2 weeks. The urine of rats was collected separately during the day-time and the night-time. The urinary level of melatonin was quantified by gas chromatography–mass spectrometry (GC–MS) with the simultaneous analysis of melatonin and its precursors. Our results suggest that night-time long-duration exposure to high energy RFID may significantly induce suppression of melatonin synthesis, although changes under the same-level exposure during the day-time did not reach statistical significance. We also suggest that decreased melatonin synthesis was related to suppression of CREB phosphorylation followed by decreased AANAT transcription

Keywords: RFID. melatonin. night

1. Introduction

The rapid expansion of mobile telecommunication services over the last decade has dramatically increased the amount of radiofrequency (RF) field irradiation energies in our environment. Radiofrequency identification (RFID) is one of the recently introduced wireless RF systems, widely used in industrial applications and daily life; however, the biological health effects of the RFID system have not been studied yet.

In the past three decades has been interested in the biological effects of extremely-low-frequency electric and magnetic fields (ELF-EMF), that are commonly come crossed

encountered in residential and occupational environments[1]. In particular, many studies have been interested in ELF-EMF exposure effects on the melatonin system. Thus, forty-eight of seventy-one separate animal studies reported that ELF- EMF altered one or more elements involved in melatonin biosynthesis, secretion or metabolism[1]. Based on these animal studies, several experiments provided possible effects of radiofrequency, including RFID, on melatonin system.

Melatonin play important biological roles in reproduction[2] ageing[3], sleep[4], immune modulation[5], and brain and cell protection[6, 7]. Nocturnal melatonin synthesis in the pinealocyte, located within the rat pineal gland, is regulated by nightly release of norepinephrine (NE) from sympathetic nerves [8]. Melatonin is synthesized from serotonin by an initial N-acetylation followed by methylation of the 5-hydroxy moiety by hydroxyindoles-O-methyltransferse [9, 10]. It is known that arylakylamine *N*-acetyltransferase (AANAT) catalyses the conversion of serotonin to N-acetylserotonin [11, 12]. As AANAT is the rate-limiting enzyme in the biosynthetic pathway of melatonin, monitoring of its activity regulating melatonin is of particular importance.

In this study, we investigated the influence of 915 MHz RFID on the melatonin system and its possible mechanism.

2. Figures and Tables

Nocturnal levels of melatonin and serotonin were estimated in the rat after after night-time and day-time whole body exposutre to 915 MHZ RFID for 2weeks (whole body SAR 4W/kg). To determine the melatonin and serotonin levels, 24 hr-urine was collected and urinary level of 6-OHMS and serotonin were quantified. Although the urinary level of serotonin was unchanged, the urinary 6-OHMS excretion was significantly reduced in 8 hr exposure group (P=0.003, Figure 1a and b), but not in the 1 hr exposure group. Histological observation of the pineal gland showed that there was no significant difference between the cage- control group, the sham exposed and the RFID exposure group (Figure 1c).

Nocturnal gene expression of arylakylamine *N*-acetyltransferase (AANAT was significantly decreased only in the RFID exposed group, compared to sham–exposed and cage-control groups (p=0.004). In addition, western blot analysis showed that both phosphorylated AANAT and AANAT were decreased markedly by RFID exposure (Figure 2a and b). Activity of AANAT was also significantly decreased at mRNA level (p=0.007) (Figure 2c and d).

Similarly, immunoblot analysis showed that phosphor-CREB was decreased in the rat pineal gland only in the RFID exposure group, as compared to the sham-exposed group in which CREB was unchanged. These findings suggest that long duration high energy exposure to RFID may suppress melatonin synthesis. The mechanism of melatonin synthesis suppression was related with suppression of CREB phosphorylation, followed by decreased AANAT transcription (Figure 3).

3. Statistical analysis

RNA band intensity was analyzed using Quantity One 1-D analysis software, v 4.6.5 (Bio-Rad Laboratories, Inc., CA, USA). The protein density of each band was quantified by imageJ software. The mean melatonin hormone of the control, sham and RFID-exposure group was compared using the Mann-Whitney U test. Results have been expressed as Mean ± SEM. P-value less than 0.05 was considered statistically significant. Statistical analyses were performed using SPSS software (SSPS 12.00 Inc., Chicago, IL, USA).

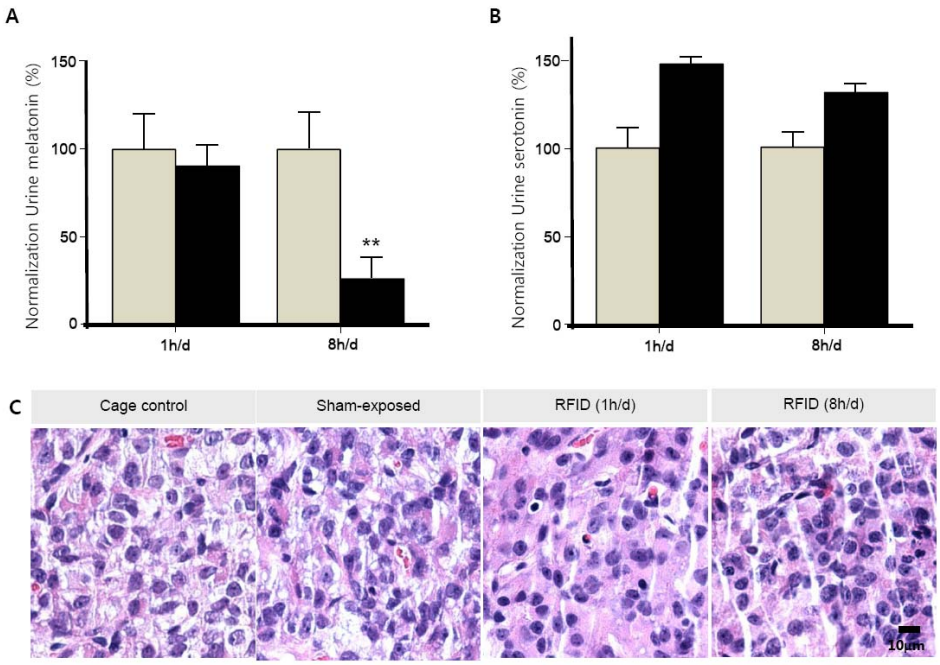

Fig. 1. Comparision of urinary level of 6-OHMS /serotonin and histological finding of pineal gland

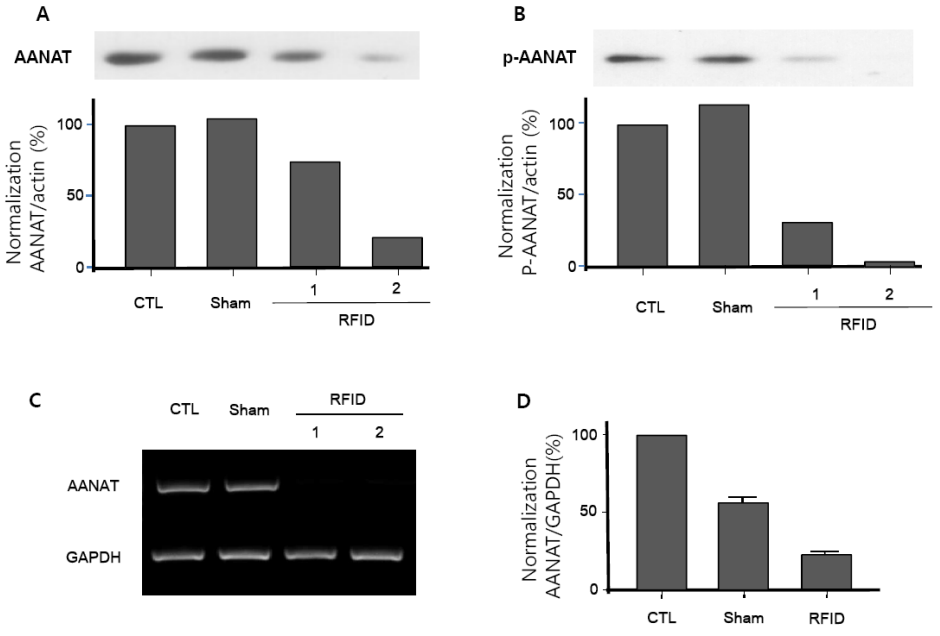

Figure 2. Activity of AANAT and p-AANAT in pineal gland: Western blot and RT-PCR .

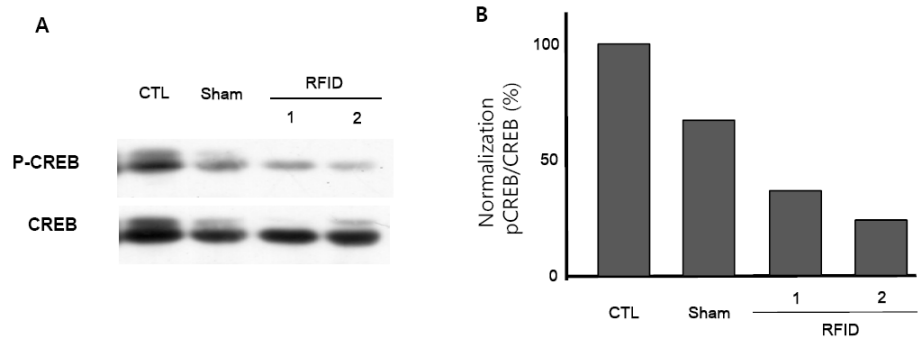

Figure 3. Western blot analysis of CREB and p-CREB activity in pineal gland.

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